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ABSTRACT

This eighth edition of the Rehabilitation Research and Training (RT) Centers reports the FY 1978 research activities of nineteen RT Centers (eleven medical, three vocational, three mental retardation, and two deafness). These research activities focus primarily on the areas of severely handicapped and independent living rehabilitation. The 259 abstracts included in this directory are organized under the conducting RT Centers which are located at the following institutions: New York University, University of Minnesota, University of Washington, Baylor College of Medicine, Emory University, Tufts University, Temple University, The George Washington University, University of Colorado, University of Wisconsin, University of Arkansas, University of West Virginia, University of Oregon, University of Alabama in Birmingham, Northwestern University, Texas Tech University of Wisconsin-Stout, and University of California at San Francisco. Preceding the abstracts under each RT center are listings of that center's core areas of research, completed projects, continued projects, discontinued projects, new projects, and proposed projects. Each abstract includes project objectives, methodology, findings, and applicability. The name of the principal investigator, status of the research activity, and relevent fiscal data are included in bolder type. Both a subject index and principal investigator's index are provided. (BM)

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Research

Directory of the Rehabilitation Research and Training Centers

Fiscal Year 1978

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Washington, D.C. 20201
December 1978

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INTRODUCTION

This FY 1978 Research Directory of the Rehabilitation Research and Training Centers (RT Centers) has been prepared for distribution to local, national and international rehabilitation service agencies, institutions, and consumer groups. It is another of many efforts made by the Special Centers' Information Exchange Program to organize and extensively disseminate new knowledge that results from research, thereby promoting its universal application.

Included in this eighth edition are the coordinated efforts of the nineteen Rehabilitation Research and Training Centers (11 medical, 3 vocational, 3 mental retardation, and 2 deafness) which serve as unique RSA programs focusing on priority areas of severely handicapped and independent living rehabilitation. The 259 abstracts contained in these pages reflect the continuous sequence of activities involved in the RT Centers' uniquely synergistic mission: to undertake research and produce new knowledge which will improve rehabilitation methodology and service delivery systems, alleviate or stabilize handicapping conditions, and promote maximal social and economic independence; and secondly, to establish teaching and training programs to disseminate and promote the utilization of the research findings, thereby reducing the usual time lag between the discovery of new knowledge and its wide application in practice.

The RT Centers have additional training responsibilities which include increasing the numbers of rehabilitation personnel in fields where acute manpower shortages exist; training rehabilitation research and service personnel; incorporating rehabilitation education into all rehabilitation related university undergraduate and graduate curricula; and improving skills of rehabilitation students, professionals, paraprofessionals, volunteers, consumers, parents, and others currently participating in the rehabilitation process. These objectives are achieved through short and long-term inservice and continuing education programs including seminars, workshops, courses of study, conferences, and demonstrations – all for the ultimate purpose of improving those rehabilitation services that are helping citizens with handicaps achieve the most productive lives possible.

In presenting the individual abstracts in this publication, researchers have supplied project objectives, methodology, findings, and applicability. The name of the principal investigator, status of the research activity, and relevant fiscal data are also included in **bolder type**. To expedite the location of individual research abstracts, both a subject index and a principal investigator index are provided. Each abstract is assigned an accession number to permit easy location.

The Project Director's name and the address of the Center are provided at the beginning of each Center's research listing and again at the end of the directory where it is accompanied by the name of the Director of Research. Requests for further information concerning individual research activities should be addressed **directly to the Project Director of the appropriate Center.**

Other Special Centers Office publications include the **INFORMER**, a quarterly journal, and the annual **Publications and Audiovisual Aids Directory of the Rehabilitation Research and Training Centers**. For further information concerning these publications write to Rehabilitation Services Administration, Mary Switzer Building, Room 3058, Washington, D.C. 20201.

Joseph Fenton, Ed.D.
Executive Editor

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New York University (RT-1)
Medical Rehabilitation Research and Training Center

CORE AREAS

Orthotics-Prosthetics

Activities designed to yield immediate and practical improvements in the design and fitting of devices to aid amputees, as well as patients suffering from neuromuscular and / or skeletal disorders.

Neuromuscular Diseases

Activities designed to develop and apply new findings to aid in the rehabilitation of individuals with neuromuscular malfunction. These activities include evaluation techniques, research in neurophysiology and electrodiagnostics, with continuing application to the patient's functional abilities.

Behavioral Science

There are three foci to this program: a) Psycho-social behavior, b) Accountability, and c) Perceptual-cognitive disturbances in brain damaged persons. The program currently focuses on assessment intervention techniques and on the development of "rehabilitation indications".

Cardiopulmonary

Activities designed to aid in the remediation of deficits originating from respiratory and cardiac disorders. This includes both diagnostic and treatment aspects.

Bioengineering

Activities designed to meld engineering and medicine in the solution of disability related problems.

Regional Spinal Cord Injury Center

All of the above core areas interact and interface with the Regional Spinal Cord Injury Center (at the Institute of Rehabilitation Medicine and the Department of Neurosurgery, New York University Medical Center).

NEW YORK UNIVERSITY MEDICAL CENTER

Howard A. Rusk, M.D., Director
New York University Medical
Rehabilitation Research and Training Center
400 East 34th Street
New York, New York 10016

PROJECT TITLES BY FY 1978 STATUS

COMPLETED — ABSTRACT NO.

Regulation of Regional Intracerebral Circulation During Injury and Aging (J.N. Baker, Ph.D.) 001

Application of Ozone to Infected Wounds and Pressure Sores in the Management of Chronic and Acute Urinary Tract Infections (B.H. Fischer, M.D.) 002

Hyperbaric Oxygen Treatment of Pressure Sores and Certain Skin Ulcerations (B. Fischer, M.D.) 003

Electrophysiological Studies in Neuromuscular Diseases (J. Goodgold, M.D.) 004

Longitudinal Study of the Effect of Rehabilitation on Factors such as Job Placement, Maintenance of Employment of Patients with Obstructive Pulmonary Disease (A. Haas, M.D.) 005

Work Classification of Patients with Obstructive Pulmonary Diseases Following Rehabilitation (A. Haas, M.D.) 006

CONTINUING

Zinc Sulphate in the Treatment of Various Skin Disorders (B.H. Fischer, M.D.) 007

Orthotics and Prosthetics Design Improvements (H.R. Lehneis, Ph.D.) 008

Bone Mineralization in Spinal Cord Injured Man: A Biochemical and Radiologic Investigation (N.E. Naftchi, Ph.D.) 009

Sympathetic Activity and the Metabolism of Biogenic Amines in Spinal Cord Injured Patients (N.E. Naftchi, Ph.D.) 010

Dysfunctions of Endocrine Glands in Spinal Cord Injury (N.E. Naftchi, Ph.D.) 011

Evaluation of Various Electronic Devices to Increase Mobility and Independence of Very High Level Quadriplegic Patients (Above C-5) (H. Sell, M.D.) 012

Demonstration of Benefits of Early Identification of Psychosocial Problems and Early Intervention Toward Rehabilitation of Cancer Patients (L. Diller, Ph.D.) 013

New York University Medical Center

Motor Conduction Velocity Measurement in Myotonic Dystrophy (A. Eberstein, Ph.D.) 014

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Electronic Anal Sphincter Stimulation for Fecal Incontinence Control and Barium Enema Examination of Disabled Persons (B.H. Fischer, M.D.) 017

Feedback Control Systems for the Paralyzed (W. Frisina, B.E.) 018

Development of Transfer Devices for High Quadriplegic Patients (R.G. Wilson, M.S.) 019

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NEW

Factors Underlying Improvement in Respiratory Function Following Cervical Cord Injury (F. Haas, Ph.D.) 021

Quantification of Electromyography with Computer Analysis (A. Eberstein, Ph.D.) 022

DISCONTINUED

Development of Electronic Systems to Provide Increased Vocational Independence and Recreational Facilities for High Level Quadriplegics (Above C-5)

Thermographic Anatomy of the Back and the Objective Diagnosis and Evaluation of Back Pain by Means of Thermography

Pathomechanics of Upper Limbs as a Basis for Improved Prosthetic and Orthotic Design

DEFERRED

Muscle Re-Education in the Hemiparetic Patient by Use of EMG Feedback

Rehabilitation of Cognitive and Perceptual Defects in People With Traumatic Brain Damage

PROPOSED

Communication Disorders in Adults With Traumatic Brain Damage

Factors Which Contribute to the Homemaking Potential of Aphasic Women

New York University Medical Center

001 Regulation of Regional Intracerebral Circulation During Injury and Aging

Principal Investigator:	**J.N. Barker, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1966-December 1976**	
Cost:	**Annual $11,112** **RT Annual $11,112**	**Projected Total $233,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 7, R-2**	

OBJECTIVES: Our objectives are to learn how to diagnose and correct slow brain blood flows in localized regions of the human brain.

METHODOLOGY: Xe-133 is utilized for in vivo measurements of regional and local cerebral blood flows; C-14 and H-3 antipyrine method, if rats or monkeys are sacrificed for truly local flow measurements. The stimulated fluorescence technique involves injection of non-diffusible contrast media, radiation of a minute volume of brain with an x ray source, and analysis of the fluorescence released thereby with a solid state detector system. The only volume seen is that included in the intersection of the beams from the radiation source and detector viewing area, the precise volume being set by collimation of the beams. It can be very small, of the order of a cubic millimeter. The ultrasonic procedures require only that a probe be placed on the skin over the carotid or other artery. The time for the sound return measures the arterial diameter while the shift in sound frequency measures velocity of flow. From these, flow in the vessel can be calculated. When it is desirable to know the size of the head as in early infancy to calculate brain volume, the biostereometric technique devised by Herron at the Texas Institute for Rehabilitation and Research will be used until a more simplified procedure is devised.

Subjects are aged rats, genetically hypertensive and hypotensive rat strains, and rhesus monkeys, with ultimate application to man in a concurrent project. Human brains are also being studied.

FINDINGS TO DATE: Local brain blood flow in more than 200 aged rats with human-type spontaneous diseases provided information needed for design specifications for new nuclear diagnostic instrumentation capable of making similar measurements for human brain. The studies also provided information concerning the nature of the difficulty at the local level and insights concerning approaches to their correction. Developmental aberrations of microvasculogenesis were shown to predispose to stroke in genetically hypertensive and hypotensive rat strains. Early modules of the instrumentation were used to detect flow impairments in half of a series of 21 rhesus monkeys who displayed permanent neurologic sequelae after elective premature delivery. The course of events and even magnitude of flows were very similar to those of perinatal rats whose rate and extent of formation of new capillaries could be demonstrated to be proportional to flow x plasma solutes = delivery of supplies to the brain. Quantitative analysis of existing data on microvasculogenic rates in man suggest that ultrasonic blood flows could detect impaired microvasculogenesis as a diminished slope of increase over several days. Complete reversal of impairments might then be anticipated if corrections were promptly achieved, or would be limited to those regions already affected as in monkeys. The critical intensive microvasculogenic period is coincident with the human premature period, placing these infants at high risk in the 50% who do not make rapid birth transitions. Since misdirection of the microvasculogenic feedback loop accounts precisely for the types and locations of the most common neuropathologic findings in perinatal brain impairments, early ultrasonic screening and intervention to restore optimal conditions for microvasculogenesis is recommended as the approach which should successfully eliminate many potential cases of cerebral palsy, mental retardation, and epilepsy. Nutritional needs for capillary formation are 13 times greater than at other stages, and are likely to be more than 26 times greater if delayed growth is synchronized with scheduled growth during recovery phases. Both rapid blood flows and adequate nutrition are essential for normal microvasculogenesis and brain growth. These needs are at levels much greater than anyone has previously suspected.

APPLICABILITY: The product of this research is a new instrument and method for general purpose use in screening and diagnosis of cerebrovascular disorders, and a firm foundation of knowledge upon which to base improved therapies. It is anticipated that neuroradiologists will use this product to aid neurologists and neurosurgeons in planning their therapies, and that psychiatrists and geriatrists will use it for more precise selection of those with organic and correctable functional disorders, that preventive medicine personnel will utilize it for screening early changes at a time when they might still be reversible in high risk cases, that pediatricians will check to see if a large percentage of premature infants can be saved from brain impairment by restoration of blood flow in the early period after birth, that spinal cord centers will use it to attempt to limit residuals of cord injuries, and that rehabilitation centers will be provided with a population in which lesser severity of disabilities will permit more adequate performance by patients. Some years will obviously be required to achieve these potential benefits for the several million patients involved. Many of these diseases are more prevalent in minority groups.

002 Application of Ozone to Infected Wounds and Pressure Sores and in the Management of Chronic and Acute Urinary Tract Infections

Principal Investigator:	**Boguslav Fischer, M.D.**	
Status:	**Completed**	
Dates:	**June 1970-December 1976**	
Cost:	**Annual $2,097** **RT Annual $894**	**Projected Total $21,000** **RT % of Annual Total 43%**
Annual Report Reference:	**#16, Page 22, R-23**	

OBJECTIVES:

1. Design and construction of a fool-proof ozone circuit permitting direct application of ozone to the infected area with total elimination of any danger to the patient and operating personnel.
2. Establishment of optimal ozone concentration necessary to actively arrest or annihilate any bacterial growth as well as the duration of action.
3. Efficient reduction of ozone concentration level at the exhaust circuit.

METHODOLOGY:

1. The instrumentation necessary for direct ozone application to infected wounds consists of:
    a. An ozone generator delivering necessary quantities of ozone in pre-selected concentrations,
    b. calibration instrument to actually measure the concentration of generated ozone,
    c. ozone applicator – either in form of a hermetic cup or as a chamber with hermetic enclosure,
    d. de-ozonizing unit reducing ozone to zero-level at the exhaust circuit.
2. Patients will be selected from the New York University Medical Center
3. The results will be monitored by photographic documentation, actual measurements of treated lesions and serial bacterial cultures during the course of treatment.
4. Additional studies will be performed on bacteria in vitro.

FINDINGS TO DATE: Ozone in concentration from 50 to 500 ppm was applied directly to infected pressure sores and certain skin ulcerations. Specially constructed ozone chambers and circuits were used with de-ozoning units at the exhaust circuit. Rapid clearing of the infected lesions was observed.

It was impossible to keep the ozone circuits completely hermetic. Despite extensive modifications and refinements of the equipment there was always a minute leak of ozone to the ambient atmosphere. Since ozone is extremely toxic to the pulmonary system it is felt that the hazards are too great and do not justify whatever beneficial effect ozone has on infected pressure sores and skin ulcerations.

APPLICABILITY: The objectives of the project literally deal with the base of any vocational and rehabilitation effort since the prospective patient must first be cleared from any skin break-down and pressure sores before any rehabilitation process can start.

New York University Medical Center

003 Hyperbaric Oxygen Treatment of Pressure Sores and Certain Skin Ulcerations

Principal investigator:		**Boguslav H. Fischer, M.D.**
Status:	**Completed**	
Dates:	**July 1971-December 1976**	
Cost:	**Annual $15,254** **RT Annual $6,830**	**Projected Total $51,000** **RT % of Annual Total 45%**
Annual Report Reference:	**#16, Page 27, R-28**	

OBJECTIVES:

1. Development of a low pressure hyperbaric oxygen chamber permitting the treatment of upper and lower extremities.
2. Development of a pressure controlled sealing cuff which would eliminate the danger of tourniquet effect.
3. Development of control mechanism permitting the application of pulsating hyperbaric oxygen within a range from 0 to 50 mm Hg.

METHODOLOGY:

1. The problems involved in the construction of the pressure cuff and a pulsed hyperbaric oxygen chamber requires the cooperation of technologists in the engineering and material sciences and those who have clinical care of the patient.
2. Major help was received from companies like the Topox Corp., Emmerson Corp., International Paper Corp., Simmons Co., Dielectrics Co.
3. Patients were selected from the New York University Hospital as well as other hospitals which are equipped with proper instrumentation.
4. The progress of the therapy was monitored by means of photographic documentation, actual measurements of the size of the treated lesions and serial bacterial cultures. In suitable cases the capillary pressure was determined.
5. Patients who present intractable lesions of at least three months duration are the most favored ones for this type of treatment since they offer the best opportunity for proper documentation of the efficacy of this treatment modality.

FINDINGS TO DATE: Hyperbaric Oxygen was applied topically to presssure sores and certain skin ulcerations using either constant or pulsed pressure in the range from 5 to 50 mm Hg. In many cases hyperbaric oxygen proved to be the only modality capable of reversing a pre-gangrenous process ultimately leading to total healing. The healing time was substantially reduced in the majority of cases.

Sufficient basic vascular supply of the lesion seems to be of paramount importance for this type of treatment. Deep ulcerations with total destruction of the dermal layer and co-existing undermining were cleared by hyperbaric oxygen from infection with corresponding stimulation of granulation. Nevertheless they failed to heal entirely necessitating plastic surgery repair.

Ischial tuberosity lesions are not regarded as an indication for oxygen treatment. Healed lesions quickly broke once the patient assumed sitting position. It is felt that these lesions necessitate plastic surgery repair with stream-lining of the ischial tuberosity and creation of a protective flap of sufficient thickness to assure proper padding effect while in sitting position.

The method of pulsed hyperbaric oxygen appears to be superior to constant pressure since in addition to delivery of pressurized pure oxygen it actively assists in arterio-venous circulation. Without exception, hyperbaric oxygen proved to be successful in rapid control and enhancement of healing of infected post-surgical wounds. The method is very inexpensive, simple and can be applied directly on wards without any modifications or additional installations in the rooms. The method is exceptionally safe, easy to operate and very well tolerated by patients.

APPLICABILITY: Topical Hyperbaric Oxygen treatment presents a new tool to successfully shorten the hospital stay and treatment period of a patient.

Any rehabilitation program is effectively stalled by the occurrence of even one pressure sore or a skin break-down. Infected post-surgical wounds are a dreaded complication which prolongs hospital stay increasing the over-all hospital costs.

004 Electrophysiological Studies in Neuromuscular Diseases

Principal Investigator:	**Joseph Goodgold, M.D.**	
Status:	**Completed**	
Dates:	**February 1967-November 1976**	
Cost:	**Annual $51,507** **RT Annual $40,611**	**Projected Total $632,000** **RT % of Annual Total 79%**
Annual Report Reference:	**#16, Page 41, R-48**	

OBJECTIVES: The specific objectives of this project were as follows:

1. To induce myotonia in Wistar rats with 20, 25 diazacholesterol.
2. To compare symptoms and signs of experimental myotonia with the human form of the disease.
3. To determine if increased plasma desmosterol levels leads to the induction of myotonia.
4. To measure the conduction characteristics of peripheral nerves of myotonic animals and compare with normal controls.
5. Determine whether myotonia can be induced in denervated muscle.

METHODOLOGY: This study was undertaken to determine whether the nerve supply to the skeletal musculature, though not involved in maintaining the abnormality, is essential in its onset. Twenty-four male white Wistar rats (125 gms body weight) were surgically denervated by excision of a segment of the sciatic nerve from one hind limb. The animals were divided into three groups: one group was given daily subcutaneous injections of 20, 25 diazacholesterol (13 mg/kg) for 3 to 4 weeks, beginning immediately after denervation. A second group was given similar injections starting 5 days after surgery for 4 to 6 weeks. A third group was not injected.

FINDINGS TO DATE: The frequency of spontaneous electrical activity was much greater in the denervated muscles of injected rats than in the noninjected group. In the injected denervated muscles, insertion activity was prolonged over many seconds; percussion gave rise to a burst of potentials which was not observed in the control group with denervated muscles. The contractile response response of denervated muscles of injected rats more clearly demonstrated the effect of diazacholesterol. The denervated muscles had a prolonged relaxation time which extended well over five seconds.

The results of this study show that diazacholesterol can alter the electrical and mechanical properties of denervated muscles, and that the changes are characteristic of myotonia.

APPLICABILITY: The result of this investigation is significant to the clinician as well as the scientist. For the clinician our findings will aid in diagnosis of neuromuscular disease; for the scientist it represents a better understanding of the disease process. The results demonstrate that the nervous system is not involved in producing this disorder.

005 Longitudinal Study of the Effect of Rehabilitation on Factors such as Job Placement, Maintenance of Employment of Patients with Obstructive Pulmonary Disease

Principal Investigator:	**Albert Haas, M.D.**	
Status:	**Completed**	
Dates:	**January 1970-December 1977**	
Cost:	**Annual $35,482** **RT Annual $19,310**	**Projected Total $177,000** **RT % of Annual Total 54%**
Annual Report Reference:	**#16, Page 201, R-49**	

OBJECTIVES: This longitudinal study was designed to demonstrate the practicality and effectiveness of a properly planned and implemented rehabilitation program for COPD patients. The area of particular concern is the improvement of their psychosocial and vocational status.

METHODOLOGY: Our basic purpose was to examine the population served by a large municipal hospital for chronic obstructive pulmonary disease to determine what percentage, if any, does not really need welfare support because they are capable of being rehabilitated for remunerative work. Of the more than 900 patients we have screened over the past seven years, a total of 191 (149 male and 42 female) demonstrate the potential for long-term employability.

FINDINGS TO DATE: Since the study of the patients themselves has now finished, the collected data will be analyzed and, in conjunction with our study of the predictability of work classification for patients with obstructive pulmonary disease, will constitute the final report.

APPLICABILITY: It is expected that once the study is terminated the result will be constituting a final report and a clarification of who should undertake the application of rehabilitation medicine, the chest physician or the rehabilitation medicine specialist, will be determined. It is also anticipated that step-by-step comprehensive, all-inclusive care will be worked out and accepted by the different departments of rehabilitation medicine in this country. The findings of this study will result in a bi-monthly bulletin which will be sent to different agencies, as well as medical journals, and will be kept up on a twice yearly basis.

006 Work Classification of Patients with Obstructive Pulmonary Diseases Following Rehabilitation

Principal Investigator: **Albert Haas, M.D.**
Status: **Completed**
Dates: **January 1970-December 1977**
Cost: **Annual $36,691** **Projected Total $200,000**
RT Annual $30,419 **RT % of Annual Total 83%**
Annual Report Reference: **#16, Page 207, R-53**

OBJECTIVES: This project will demonstrate that a comprehensive, well-planned rehabilitation program based on realistic and individualized patient goals can achieve significant and enduring effects. It will also demonstrate that a multi-disciplinary approach coordinated under one roof is indispensable to a successful rehabilitation effort. A dynamic rehabilitation plan will be constructed, indicating the step-by-step application of such a well-organized program. The study will also result in the development of work classification categories based on the following energy-cost fields: low, medium, high, heavy.

METHODOLOGY: Two groups of patients, experimental and control, have been selected for this study. Each group contains 125 patients with a ratio of 4 males to every female. The patients in both groups undergo a routine x-ray, clinical and laboratory evaluation, including pulmonary function testing by spirometry, plethysmography to measure airway resistance and compliance, and a determination of pulmonary diffusion capacity and blood gas determination both at rest and exercise. These tests constitute the baseline study necessary before starting the work classification study. The patients are then prescribed relaxation exercises, postural drainage, breathing exercises, and oxygen exercises. Once these therapeutic exercises have been learned, the patient is given varying work loads starting with a minimum of 300kgm/min. A three minute warmup period allowing the patient to reach or approximate a steady-state is followed by five minutes of exercise at a chosen work load. Laboratory procedures, based on energy-cost studies, are used to develop a reliable work classification for each patient. Before exercise as reference point, an analysis is made of oxygen consumption while sitting. During the exercises, as well as during the warm up period, minute-by-minute oxygen consumption heart rate and oxygen debt are measured to determine if and when the patient reaches his breaking point. Upon cessation of the exercise, heart rate and blood pressure are measured while sitting. A breath-by-breath analysis is made of the expired gas to determine the contracted oxygen debt and the time to recover from it. Blood gas analyses, such as oxygen tension saturation and CO_2 tension, PH and acid-base balance are monitored as well. The tolerated work load is translated into actual work activities in one of the different energy-cost fields, and these activities are then carried out in a workshop setting.

FINDINGS TO DATE: To date 610 patients have been screened for this study. 117 males and 21 females (138 in total) have been chosen with the following results:

1. Basal metabolic rate before the reconditioning exercises ranged from + 14, and from + 5 after the reconditioning exercises.
2. The range of respiratory exchange ratio was 0.5 to 1.0 before reconditioning exercises, tending to stabilize at 0.7 to 0.8 after these exercises.
3. Patients reached a steady state while at rest but only approached it during exercises. After the reconditioning exercises the patient failed to reach a complete steady state, although the contracted oxygen debt became somewhat smaller and the rate of recovery was shorter. Duration and tolerance to the minimum workload exercises (of 400 kg meters/ minute increased by a ratio of 1·3. Similar results were observed when the patient did small assembly work in a sitting position. The heart rate in B.P. remained within normal limits during the appropriate exercises.

Preliminary analysis of the collected data indicates that in relation to cardiopulmonary function, the maximum tolerable work load is 600 kg meters/minute for this patient group. This allows them to complete a 7-hour work day. the work load classifications are defined according to the following: 1) up to 200 kg meters/minute pertains to self-care: 2) 200-600 kg meters/minute pertains to sedentary (such as clerical and assembly work) and light standing jobs (like bench work involving lifting of no more that 2 to 4 lbs. only for short distances). The 54 patients placed in jobs maintained them for from 8-32 months. Seven patients, however, had to discontinue because of acute respiratory infection and undergo another re-evaluation.

APPLICABILITY: Patients with COPD are generally unable to return to and maintain steady employment because most of the present rehabilitation programs are not properly planned and vocational goals are inappropriately chosen. Successful vocational rehabilitation is contingent upon a reliable work classification to determine the occupational field in which the patient can successfully maintain a favorable status. These work classifications also provide a tool for determining the extent of an individual patient's capacity for successful retaining. One can then discriminate between those patients in whom the investment of retraining funds would be reasonably worthwhile and those in whom such an investment would not be productive.

007 Zinc Sulphate in the Treatment of Various Skin Disorders

Principal Investigator:	**Boguslav H. Fischer, M.D.**	
Status:	**Continuing**	
Dates:	**June 1970-December 1980**	
Cost:	**Annual $13,541** **RT Annual $8,191**	**Projected Total $158,000** **RT % of Annual Total 60%**
Annual Report Reference:	**#16, Page 34, R-30**	

OBJECTIVES: There is evidence that a major zinc loss occurs in any form of prolonged immobilization of the human body accompanied by muscular wastings. 60% of body zinc is stored in the muscular system.

Problems:

1. Rate of zinc loss in patients immobilized for prolonged periods of time.
2. Relation of plasma zinc levels to ulcerations of the skin.
3. Doses of zinc sulphate to be administered daily in order to maintain adequate zinc level in body tissue.
4. Action of zinc in acceleration of healing of existing skin break-downs.

METHODOLOGY:

1. Patients will be drawn from the New York University Medical Center including Manhattan's Veteran's Administration Hospital. Blood samples will be drawn using stainless steel needles and all-glass syringes, immediately spun down and stored in frozen state in rubber-less containers.
2. Zinc concentration will be determined on a bi-weekly basis starting from the day of disability or injury, and conducted for at least six months.
3. Oral supplementation will be performed using Zinc Sulphate in capsules, 220 mgm each, three times per day equaling 150 mgm of elementary zinc. This amount proved too sufficient to replenish zinc stores without untoward reactions, chiefly in form of gastro-intestinal irritation.

FINDINGS TO DATE: Serum and urinary zinc concentrations were measured in 31 patients presenting central nervous systems disorder in the form of paraplegia or quadriplegia, diabetes with chronic ulcerations, rheumatoid arthritis and Parkinson disease.

Low serum zinc levels were found in patients presenting chronic ulcerations of the skin which resisted standard methods of treatment.

Low serum zinc levels were found in patients treated chronically with corticosteroids and with Parkinson disease.

Patients with a skin ulceration of recent onset had a normal zinc level. Therapeutic trials were performed in four patients presenting chronic ulcerations.

Two patients had a normal serum zinc level. The administration of zinc sulphate -- 200 mgm Tid -- did not affect the status of the ulcerations. There was no response in one patient with low serum zinc and a pressure sore. In two patients with low serum zinc levels there was a visibly accelerated granulation and epithelium formation once they were started on zinc sulphate supplementation.

The administration of zinc sulphate appears to be safe and well tolerated. There were no hematological, hepatic and renal changes in all patients receiving zinc supplementation for at least four months in a dosage of 660 mgm/day.

The accumulated data are too scant to draw any valid conclusions. The results, however, give the encouragement for further proceeding with the study.

Stringent sampling technique must be applied in order to prevent or minimize the danger of contamination of samples with external zinc.

APPLICABILITY: Proper maintenance of the skin integrity is of fundamental importance for a full course of rehabilitation and vocational therapy.

008 Orthotics and Prosthetics Design Improvements

Principal Investigator:	**H.R. Lehneis, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1966-October 1978**	
Cost:	**Annual $47,046** **RT Annual $46,746**	**Projected Total $520,000** **RT % of Annual Total 99%**
Annual Report Reference:	**#16, Page 137, R-59**	

OBJECTIVES:

1. **Pressure Mapping:** to establish and test a clinically applicable method of graphically quantifying static pressure over large complex surfaces at all points simultaneously.
2. **Universal Terminal Device:** A prosthetic terminal device is being developed that provides function similar to that of a hook but looks like a hand. This is to eliminate that stigma associated with the appearance of a hook, yet to provide the superior prehensile function of a hook.
3. **Electric Arm Orthosis:** A powered orthosis is being developed that provides prehensile function as well as essential degrees of freedom for arm functions to allow for needs of Activities of Daily Living and to reach certain vocational goals.

METHODOLOGY: **Pressure Mapping, Universal Terminal Device and Electric Arm Orthosis.** Pressure mapping was completed and the final report submitted in last year's report. This year's report is concerned with the remaining two projects, universal terminal device, and electric arm orthosis.

Universal Terminal Device. Subject population in this project consists of below-elbow and above-elbow amputees, rather than higher levels of amputation since the B/E and A/E amputee is a generally more active user of his prosthesis than higher level amputees. In addition, their vocational potential is greater in general. Testing procedures are standard procedures used in occupational therapy in training amputees which record performance in standard tasks expected of the amputee. In addition, a questionnaire has been developed which aims at a comparative evaluation between standard terminal devices and the universal terminal with regard to performance from the patient's point of view, as well as acceptance and convenience.

Electric Arm Orthosis. The subject population in this project are quadriplegics above the C-5 i.e., who are unable to place their hand or arm in space and do not have prehension. The age range is between 18 and 65, i.e., patients who have either college training or vocational potential. An objective evaluation of both designs by an independent institution is also planned.

FINDINGS TO DATE:

1. **Pressure Mapping:** The constraints of the specific clinical applications described in the previous and present report and other experience have led to a refinement of the pressure mapping technique to the extent that the project can be considered complete as of this report. In summation, the methodology evolved through three distinct phases:
    1. Quantification of a microcapsule system
    2. Modification and utilization of above microcapsule contents.
    3. Use of reactants in 2 above, again modified, to be compatable with an altered physical configuration of the transducer.
2. **Universal Terminal Device:** During the past year efforts were directed, in part, to a more formal interdepartmental approach to the problem. This not only facilitated the "take-home" evaluation but should assist dissemination.

    During this period, two of our prototypes developed were fitted to patients who were allowed to use these devices outside the laboratory. They were, nevertheless, used only in their homes since good cosmesis has not yet been achieved. Also, the problem of durability has not yet been solved so that long term use was not possible. Nevertheless, patient reaction was favorable and encouraging.
3. **Electric Arm Orthosis:** As a result of patient tests the control system was refined from three independent switches mounted in the head piece through a "joy stick" – like lever arm such that contact with the control system is continuously maintained. This insures the "referring" that is necessary to "find" the proper switch at the proper time and also reduces head motions needed. The cosmesis of the control system was also greatly improved.

    A four degree of freedom powered arm orthosis is being developed to compliment the environmental control approach, allowing the patient to function in locations other than the proximity of those systems.

APPLICABILITY: Since this system enables the clinician to predict future pressure-induced skin ulceration and allied difficulties without the use of complex, expensive equipment and additional technical assistance, the efficiency of the rehabilitation process is expected to increase and resultant costs are expected to decrease. Consumers will be the general upper limb amputee population who currently use one or more types of terminal devices.

009 Bone Mineralization in Spinal Cord Injured Man: A Biochemical and Radiologic Investigation

Principal Investigator:	**N. Eric Naftchi, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1969-September 1979**	
Cost:	**Annual $63,825**	**Projected Total $575,000**
	RT Annual $19,390	**RT % of Annual Total 30%**
Annual Report Reference:	**#16, Page 52, R-60**	

OBJECTIVES:

1. To determine the causes of excessive bone demineralization in patients with paralysis due to spinal cord lesions.
2. To prevent demineralization.
3. To arrest and treat complications of osteoporosis by controlling calcium and phosphate metabolism.
4. To elucidate the cause of myositis ossificans and thereby prevent the restrictive, debilitating effects, either by inhibiting its formation, or once formed, cause its resorption or maturation by pharmacologic means.

METHODOLOGY:

1. The objective of this study is to arrest bone absorption and favor bone deposition by means of administering several therapeutic agents separately and in combination. The pharmacologic agents will be inorganic phosphates (Hyper-phos. K), diphosphonates, and thyrocalcitonin. The following techniques will be employed to determine successful therapy: (a) chromium corrected phosphate, calcium, magnesium, nitrogen balances will be studied for two consecutive four-day periods after appropriate equilibriation; (b) radiographic measurement of metacarpal and metatarsal cortical thickness; (c) quantitative, serial measurement of forearm and leg bone density by means of gammaphoton denistometer.
2. The results of quantitative serial measurements of bone density by simultaneous radiographic and gamma-photon densitometry and 18F uptake will be correlated with mineral balance and collagen turnover in acute and chronic quadriplegia and paraplegia. These results, in turn, will be compared in patients with a different level of spinal cord transection in acute, recovery, and chronic phases in order to determine the effects of various levels of transection of spinal cord on skeletal demineralization.

FINDINGS TO DATE:

1. Bone mineral content was measured by single photon absorptiometery using a modified Packard bone densitometer with 125 I as the source. In 45 hemiplegic subjects, matched for sex and age, the bone density was compared bilaterally on the radius and ulna two and four centimeters above the wrist. The non-paralyzed side served as a control for the paralyzed side. There was an equivalent number of right-dominant, right-paralyzed and left-dominant, left-paralyzed subjects. The results indicate a consistent, general loss of bone mineral on the paralyzed side compared with the non-paralyzed side. Right-dominant, left-paralyzed patients showed a greater loss of bone density than left-dominant, right-paralyzed subjects. The absorption ratio of the paralyzed versus the non-paralyzed sides revealed that there was a 6.8% and 7.3% decrease in the average bone density at four centimeters and two centimeters above the wrist, respectively. There was a progressive loss of bone mineral content relative to time after the onset of paralysis, amounting to an average of 5% from both sites measured approximately three months after onset of injury. The effect of physical and drug therapy on the rate of demineralization following paralysis remains to be elucidated.
2. This study was undertaken to assess the feasibility of the osteodensitometry for determination of bone mineral content. Hemiplegic subjects were chosen as simpler models in order to compare the paralyzed with non-paralyzed arm and to set-up the technique for spinal cord injured subjects who are more challenging to study. The progressive loss of bone mineral content relative to the time after the onset of paralysis will be measured as above in spinal cord injured subjects in order to determine the extent of bone demineralization and the effect of drug treatment.
3. Urinary excretion of magnesium and calcium was measured in 11 quadriplegic and 7 paraplegic subjects from the date of the onset of injury and was followed longitudinally once a week for a period of 15 to 24 weeks. Both groups of subjects excreted calcium and magnesium significantly higher than normal during the first eight weeks after the injury. The mean levels gradually decreased towards but did not reach normal levels 24 weeks later. The excretion of calcium in both quadriplegic and paraplegic subjects was of the same magnitude but the excretion of magnesium in paraplegic subjects was about 75% of that in quadriplegic subjects.

APPLICABILITY: Calcium and phosphate metabolism is deranged in spinal cord injured humans. The associated complications, kidney stone, myositis ossificans, bone pain and fractures limit the independence, employability and rehabilitation of spinal cord injured man. In the present study, under dietary control, calcium and phosphate metabolism will be determined before and after specific treatment and correlated with bone density measurements and other biochemical findings. These treatments have proven successful in arresting bone resorption and favoring bone deposition in animals and some humans with bone fractures. The development of methods for the control of calcium and phosphate metabolism in spinal cord injury is essential in order to reduce debility, protracted and recurrent hospitalization of these patients.

010 Sympathetic Activity and the Metabolism of Biogenic Amines in Spinal Cord Injured Patients

Principal Investigator: **N. Eric Naftchi, Ph.D.**

New York University Medical Center

Status:	**Continuing**	
Dates:	**September 1968-September 1979**	
Cost:	**Annual $142,613** **RT Annual $21,909**	**Projected Total $900,000** **RT % of Annual Total 15%**
Annual Report Reference:	**#16, Page 58, R-61**	

OBJECTIVES:

1. To determine the relationship between cutaneous circulation and catecholamine metabolism in paraplegic and quadriplegic subjects with the purpose of elucidating the cause of trophic skin ulcers and spacticity.
2. To measure the effect of various levels of injury on the metabolism of catecholamines and correlate the degree of derangement in regulatory, integrative and stress functions with concentration of these neurotransmitters and their metabolites.
3. To measure the degree of sympathetic activity in different levels of spinal cord injury.
4. To develop measures for reducing the incidence of decubitis ulcers in the spinal cord injured human.

METHODOLOGY:

1. Catecholamines and their metabolites will be measured in plasma and urine and spinal fluid of cord transected individuals. Various levels of cord transection and their effect on these hormones and neurohormones will be investigated. Methods used include column and bidimensional paper and thin layer chromatography, ultra-violet fluorescent and atomic absorption spectroscopy; and the use of ultracentrifuge scintillation spectometry and strip scanning for radioisotopic analysis of the hormones and ions involved. Sympathetic activity will be evaluated by reactivity of the patients to exogenously infused norepinephrine, tyramine or angiotensin. Digital calorimetry will be used for the studies on reactivity to norepinephrine or other pressor substances. Gas-liquid chromatography, mass spectrometry and infrared spectrometry will also be employed for separation and identification of unknown compounds.
2. Digital blood flow will be measured calorimetrically and by means of mercury-in-rubber Whitney strain gauge.

FINDINGS TO DATE:

1. In seven C5-C7 quadriplegic subjects blood volume was measured by means of double isotope technique, using 125 I and 51 Cr. In five other C5-C7 quadriplegic subjects autonomic hyperreflexia was induced by expansion of the urinary bladder by means of water intake. Cardiac output was measured by indicator dilution method and arterial blood pressure by auscultatory technique. During hypertension there was no appreciable change in either cardiac output or cardiac index. By contrast, there was a significant rise in mean arterial blood pressure and total peripheral resistance and a sharp fall in pulse rate. Preliminary studies on blood volume reveal that during hypertension there is a 10% rise in hematocrit but relatively little change in total blood volume. These results indicate that during hypertension there is: (1) an increase in hemoconcentration, probably due to an increase in capillary permeability; (2) hypertension is caused mainly by a pronounced decrease in blood flow of the upper and lower extremities and by a sharp increase in the total peripheral resistance. This marked vasoconstriction correlates with increased activity of serum dopamine-B-hydroxylase, the enzyme responsible for the synthesis of the neuro-transmitter, norepinephrine. This enzyme is released together with norepinephrine during hypertensive stress (Naftchi, N.E., et al, Frontiers in Catecholamine Research 1973 pp. 1143-47, Pergamon Press) and is thus an index of sympathetic activity (Naftchi, N.E., et al., Circ. Res. 35:850-6, 1974).
2. Reactivity of the digital vascular bed to infused 1-norepinephrine (NE) was measured in 15 subjects with complete physiologic transection of the spinal cord at various levels and was compared with that of 16 normal subjects. At least one hour before the test a continual bladder drainage was insured by means of an indwelling Foley catheter imbedded in Lidocaine gel. Sympathetic nerve discharge was inhibited by indirect heating of the subjects and continuous infusion of trimethaphan camphorsulfonate (TMCS), a ganglion blocking agent. Following the measurement of digital blood pressure and flow in this phase of vasodilation, vasoconstriction was brought about by infusion of NE while the infusion of TMCS continued. Flow-pressure ratios were converted to radius equivalents of digital circulation and the work of vasoconstriction was quantitated in ergs per microgram of NE infused per minute. The reactivity of NE in paraplegic subjects with lesions below the T6 dermatome was within the range found for normotensive subjects. In subjects with spinal cord transection above the T6 dermatome, reactivity to NE was more than two-folds greater than that of normotensive and paraplegic subjects with lesion below T6 dermatome. The significance of these findings with respect to denervation supersensitivity and the level of spinal cord lesion are being

investigated further.

APPLICABILITY: Too frequently, after substantial investments are made in the physical and vocational training of paraplegic and quadriplegic patients, numerous complications arise which necessitate re-hospitalization, frequently for a prolonged period, and thus jeopardize further employment of the patients in their prehospitalization job or a new job following discharge from the hospital. If through the proposed investigation the basic underlying physiological factors which contribute to decubiti, urinary infection, and other similar complications could be identified and possibly brought under control, the vocational rehabilitation of these severely disabled persons would be greatly enhanced.

011 Dysfunctions of Endocrine Glands in Spinal Cord Injury

Principal Investigator:	**N. Eric Naftchi, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1974-September 1979**	
Cost:	**Annual $136,992** **RT Annual $34,883**	**Projected Total $410,000** **RT % of Annual Total 25%**
Annual Report Reference:	**#16, Page 66, R-81**	

OBJECTIVES: The objective of this research is to examine critically endocrine function in paraplegic and quadriplegic subjects by means of exact and sensitive tools of radioimmunoassay and gas-liquid chromatography, to assay in blood the major hormones, and to analyze in urine 17-hydroxycorticosteroids, 17-ketosteroids, aldosterone, and reninangio-tensin as described in the Methodology.

METHODOLOGY: The ability of 131 I or 125 I-labelled hormones to compete with unlabelled hormones for antibody has been utilized in the radioimmunoassays for human growth hormone (1), rat (2,3) human (4), bovine (7), LH, FSH (5); and rat prolactin (6). Purified hormones are iodinated by modifications of the method of Greenwood et al., 1963 (8) using chloramine-T as the oxidizing agent.

FINDINGS TO DATE:

1. The concentration of testosterone in serum and the level of 17-Ketosteroids in urine of seven paraplegic and nine quadriplegic subjects were measured from the date of onset of the injury and were followed longitudinally once a week for a period of 15 to 30 weeks.
2. From the date of onset until three to eight weeks later, serum testosterone levels were about one-half that of normal controls but reached and remained at about normal levels thereafter. The concentrations of urinary 17-Ketosteroids followed approximately the same trend as that described for serum testosterone. Urinary 17-Ketosteroid levels, however, exhibited sharp weekly fluctuations from one-half below to low normal values. The latter results may suggest a derangement in regulation of synthesis or metabolism of androgens in spinal cord injured subjects.
3. Urinary 17-Ketosteroid levels were lower than normal values in paraplegic subjects. In quadriplegic subjects, however, 17-Ketosteroid excretion remained approximately normal. The results suggest a derangement in the regulation of synthesis and/or metabolism of neurotransmitter and androgens due to a disturbance in hypothalamic pituitary-gonadal axis.

APPLICABILITY: Since the integration of the most important biological functions in the body is carried out by the autonomic and central nervous systems as well as the endocrine glands, it is urgently necessary that we study dysfunctions of the feedback mechanism between various endocrine glands, to be capable of reversing or preventing some of the serious complications, incurred by paraplegic or quadriplegic subjects. For instance, there is no explanation as to why some patients with spinal cord injury develop stress intolerance, gynecomastia, testicular atrophy, amenorrhea, etc., all manifestations of disturbed functioning of the endocrine system.

012 Evaluation of Various Electronic Devices to Increase Mobility and Independence of Very High Level Quadriplegic Patients (Above C-5)

Principal Investigator: **Heiner Sell, M.D.**

New York University Medical Center

Status: Continuing
Dates: October 1974-September 1977
Cost: Annual $126,408 Projected Total $286,000
RT Annual $118,717 RT % of Annual Total 94%
Annual Report Reference: #16, Page 226, R-82

OBJECTIVES: The general objective of this project is to determine which electronic equipment can best be utilized in the rehabilitation of the severely disabled quadriplegic by the evaluation of various types of such equipment.

METHODOLOGY:

1. During the past year on-going investigation of existing electronic devices has been continued, as well as testing of newly introduced commercial items. In addition, prototype devices developed in-house or by outside manufacturers have been tested.
2. A total of 14 high level quadriplegics who were seen at IRM during the period June 1, 1976 to May 30, 1977 were given an opportunity to try any or all of the various electronic devices in-house at that time. Primary evaluation occurred in the electronics lab with bedside testing done when feasible. Data was collected in the areas of mechanical/electronic performance and characteristics patient operation, and patient/personnel attitudes.

FINDINGS TO DATE: Patients with high level spinal cord injuries had the opportunity to test various pieces of electronic equipment. These include breath operated powered wheelchairs and breath operated environmental controls and communication aids. In-hospital testing of all devices followed by post-discharge testing of the same and/or additional devices at home or schools permits comprehensive assesment of actual functional value of the device as well as suggesting modifications for device improvement. An open communication with manufacturers encourages incorporation of current findings. Development of in-house equipment is pursued when indicated.

APPLICABILITY: A leading international manufacturer of wheelchairs has accepted the 1-tube IRM Breath Control for production. Three prototypes from them are projected to be ready for in-house testing as a preliminary to national marketing.

The manufacturer of one environmental control device (Robot) has reported that our evaluation findings are being considered in the redesign of their device.

013 Demonstration of Benefits of Early Identification of Psychosocial Problems and Early Intervention Toward Rehabilitation of Cancer Patients

Principal Investigator: Leonard Diller, Ph.D.
Status: Continuing
Dates: June 1975-December 1978
Cost: Annual $207,997 Projected Total $723,000
RT Annual $41,967 RT % of Annual Total 20%
Annual Report Reference: #16, Page 146, R-84

OBJECTIVES: To determine 1) the relationship between classification of rehabilitation goal and classification of severity of disease; 2) the impact of cancer on patient's ADL functioning; 3) the relationship between ADL change and patient's self report of psychosocial problems.

METHODOLOGY: 136 (46 Breast, 45 Lung, 45 Sarcoma) cancer patients at least six months post initial cancer diagnosis were administered a three hour structured clinical interview. The interview was constructed so that a potential of 109 psychosocial problems could be reported by the patient. In the course of the interview, patient's ADL status was assessed using an adaptation of the Katz (1963) and Sarno (1973) scales. The surgeons were asked to evaluate their patients prognosis and medical staging of disease. Independent medical chart evaluations were performed by a physiatrist to determine level of rehabilitation goal.

FINDINGS TO DATE: Data indicate that 1) classification of rehabilitation goal and classification of severity of disease are significantly correlated; 2) ADL status declines with level of rehabilitation goal; 3) lung and sarcoma patients are more ADL impaired than breast patients; 4) the amount of ADL change was the best predictor of the total number of psychosocial problems reported by patients. These data will be discussed in terms of the impact ADL change and rehabilitation goal have on the psychosocial problems in cancer patients.

APPLICABILITY: A 1974 study sponsored by Cancer Care indicated that 75% of all the patients studied had psychosocial problems. It is a known phenomena in rehabilitation that psychosocial difficulties mediate the success of rehabilitation efforts. Therefore, knowledge relating to the interface between ADL status, rehabilitation goal, and the presence of psychosocial problems will enable rehabilitation workers to more effectively focus their efforts.

014 Motor Conduction Velocity Measurement in Myotonic Dystrophy

Principal Investigator: **Arthur Eberstein, Ph.D.**
Status: **Continuing**
Dates: **September 1975-September 1978**
Cost: **Annual $65,804** **Projected Total $188,000**
RT Annual $52,202 **RT % of Annual Total 79%**
Annual Report Reference: **#16, Page 78, R-85**

OBJECTIVES: The objectives of this study are to determine whether nerve conduction in patients afflicted with myotonic dystrophy or myotonic congenita is impaired, and whether there is any nerve involvement of parents and siblings of these patients.

METHODOLOGY:

1. Patients with clinical and electromyographic findings characteristic of myotonic dystrophy or myotonic congenita will be accepted as subjects for this study. Both female and male patients of all ages will be tested. The population sample will consist of at least 50 subjects. Control values will be those already established in this laboratory.
2. Conduction velocities will be determined in the median, ulnar and peroneal nerves and sensory latency times in the median and ulnar nerves of each subject. The procedure to be followed has been described in the book by Goodgold and Eberstein (Electrodiagnosis of Neuromuscular Diseases. Williams and Wilkins, 1972, Ch. 6). Essentially, nerve conduction velocities of motor nerve fibers are determined from measurements of the latencies of potentials evoked in the muscle after nerve stimulation at two different points along its length.
3. The mean conduction velocity and mean latency time as well as standard deviations will be calculated for each nerve, and the T-test will be applied to the means of corresponding nerves (normal vs. myotonic patients) to determine the significance of the difference.

FINDINGS TO DATE: Twenty-six afflicted with myotonia were included in this study. The average conduction velocities and latencies were calculated from the measured values obtained from each patient. For the motor fibers of the median nerve, the average conduction velocity was 55.8 ± 2.8 m/sec, and the latency was 3.3 ± 0.6 m/sec. The latency for sensory conduction of the median nerve was 2.8 ± 0.6 m/sec. Using the t-test, the differences of these values from normal were found to be not significant.

The average motor conduction velocity and latency for the ulnar nerve was 54.8 ± 6.3 m/sec, and 2.7 ± 0.5 m/sec. These values are within the normal range for conduction velocity and latency.

For the peroneal nerve of the myotonic patients, the average motor conduction velocity was 47.0 ± 8.8 m/sec and motor latency was 45.4 ± 1.8 m/sec. These are also within normal limits.

Four of the 26 patients had conduction velocities along the median nerve which were in the lower range of the normal limits (less than 50 m/sec) as well as abnormal slowing in the peroneal nerve. These patients are apparently free of any other involvement so that the slow nerve conduction may be attributed to the myotonia.

The normal values of conduction velocity and latency used in this study were as follows:

median nerve, 56.3 ± 4.8 m/sec and 3.2 ± 0.6 m/sec for motor fibers, 3.2 ± 0.2 m/sec for sensory fibers. Ulnar nerve, 58.4 ± 6.0 m/sec and 2.6 ± 0.4 m/sec for motor fibers, 3.2 ± 0.2 m/sec for sensory fibers. Peroneal nerve, 50.0 ± 6.0 m/sec and 5.0 ± 0.5 m/sec for motor fibers.

APPLICABILITY: The knowledge that the nerve is or is not involved in the disease process is important to the clinician as well as the scientist. The clinician may use this information to improve the differential diagnosis of muscle disease, prepare a program of rehabilitation and, possibly, as an early indicator of abnormality. Early and accurate diagnosis may be essential to successful treatment and, at least, partial reversal of the disease process.

Furthermore, results of this project may be utilized in the growing controversy regarding the pathogenesis of the myopathies. Any evidence that can be presented to resolve this problem is significant for the entire medical community.

015 Rehabilitation Indicators: A Method for Enhancing Accountability and the Provision of Rehabilitation Services

Principal Investigator:	**Leonard Diller, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1974-October 1979**	
Cost:	**Annual $75,891** **RT Annual $53,250**	**Projected Total $425,000** **RT % of Annual Total 70%**
Annual Report Reference:	**#16, Page 152, R-88**	

OBJECTIVES: The RI methodology, when used in rehabilitation settings, will serve several purposes (long-term goals):

1. Rehabilitation settings will become **more accountable** through a broader and more objective information flow and improved decision making, in line with the resource provider's expectations; these expectations are stated in terms of access (who is to receive services), process (what is to occur) and outcomes (the types of goals that are viewed as valid).
2. Rehabilitation settings will provide **better** services in that individual client planning, tracking and follow-up can be tied to RI's; also program planning can be more clearly tied to the types of primary goals and instrumental sub-goals addressed within the population.
3. Rehabilitation systems will be able to **define "disability"** in functional terms and define "needs" of the disabled in terms of skills and environmental supports needed to reach goals.

METHODOLOGY: The project will be implemented in three phases; Phase I initial development of RI's (October 1974 - May 1977); Phase II: Final development of RI's and field testing (May 1977 - October 1979); and Phase III: Demonstration and Utilization/Dissemination (October 1979 -);

FINDINGS TO DATE: A lexicon has been developed which consists of three sets of indicators which constitute an objective and hopefully clarified language for rehabilitation. This modified language can be implemented in many ways within varying rehabilitation systems, including the use of the lexicon within a structured interview, an unstructured interview, and/or within an observation paradigm. The particular method selected would depend on factors such as the type of client, the type of rehabilitation services and the type of rehabilitation setting.

The focus of the lexicon is behavioral and observable, but not behavioristic, in that no particular theory of behavior is adopted nor any behavior change methods.

APPLICABILITY: Status indicators, activity indicators and external factor indicators can be used within the process of rehabilitation, utilizing a basic systematic approach. In this approach the rehabilitation indicators would be used to fulfill several purposes, including defining status goals, necessary skills, and external strengths and problems, for the purpose of individual rehabilitation planning, and defining changes in status activities and external factors for evaluation purposes.

016 Modular Hyperbaric Oxygen Treatment of Pressure Sores and Traumatic Skin Lesions of the Torso

Principal Investigator:	**Boguslav H. Fischer, M.D.**	
Status:	**Continuing**	
Dates:	**October 1975-October 1980**	
Cost:	**Annual $11,290** **RT Annual $5,272**	**Projected Total $60,000** **RT % of Annual Total 47%**
Annual Report Reference:	**#16, Page 79, R-89**	

OBJECTIVES:

1. Construction of physiologically proper cups and miniature chambers permitting the enclosure of an ulceration existing on a flat surface of the human torso (Sacrum, vertebral spine).
2. Identification of proper gasketing material, either silicon or natural rubber.
3. Identification of proper durometer of the gasketing material.
4. Development of oxygen delivery system permitting either constant or pulsed pressure application of oxygen.
5. Development of proper shape of the sealing material placed between the cup and skin.

METHODOLOGY:

1. Patients will be selected from the New York University Medical Center. The progress of healing will be monitored by photographic documentation, actual measurements of skin ulcerations, and serial bacterial cultures.
2. The response of the lesions to oxygen applied under various pressures will be observed.
3. Special consideration will be given to infected post-surgical wounds on the torso since their presence not only substantially delays any rehabilitation treatment but also consititutes a grave threat to the patient's well being.
4. Several branches of the industry (plastic and material sciences) will be involved in search for proper material and construction of devices.
5. The following companies expressed their willingness to cooperate and help in the project:

International Paper Company	Sterling Forest, New York
Davol Company	Providence, Rhode Island
Dielectric, Inc.	Chicopee Falls, Massachusetts

FINDINGS TO DATE: Hyperbaric oxygen was applied topically to pressure sores of the sacrum, buttocks and to infected post-surgical wounds on the torso. In all cases (6) a prompt arrest of necrosis was observed. This was followed by rapid clearing of the lesion, enhanced granulation and epithelization. It resulted in major shortening of the healing time of lesions which resisted all previous therapeutic modalities.

Specially designed cups were used contoured along the profile of the actual skin ulceration or deficit. Oxygen was applied under pressure from 20mm Hg using either constant pressure or pulsed pressure technique.

It proved to be a most aggressive and effective means of control of post-surgical infections resulting in prompt control of the infected area with rapid healing. No side effects or untoward reactions were observed.

APPLICABILITY: Since topical hyperbaric oxygen does not require any special installations or modifications and can be applied directly on patient's wards the method may be used widely in hospitals and nursing homes with extended facilities.

It will substantially shorten the healing time permitting an earlier rehabilitation and earlier return to productive life.

017 Electronic Anal Sphincter Stimulation for Fecal Incontinence Control and Barium Enema Examination of Disabled Persons

Principal Investigator:	**Boguslav H. Fischer, M.D.**	
Status:	**Continuing**	
Dates:	**October 1975-October 1980**	
Cost:	**Annual $10,485** **RT Annual $4,467**	**Projected Total $54,000** **RT % of Annual Total 43%**
Annual Report Reference:	**#16, Page 100, R-95**	

OBJECTIVES:

1. Construction of properly shaped anal plug.
2. Construction of stimulating generators.
3. Modification of existing safety overflow system by elimination of kinking problems of the tubing and construction of an over-flow reservoir.
4. Construction of open-end manometric system permitting direct measurement of existing pressures within the colonic lumen during barium enema examination.

METHODOLOGY: Patients will be selected for New York University Medical Center both on in- and out-patient basis. They are divided into three groups.

First Group: Patients who present fecal incontinence as a major debilitating and socially handicapping factor in their rehabilitation and return to productive life. Stimulation of the anal sphincter muscle will be administered after appropriate EMG study in order to obtrain objective information. The response and degree of restoration of fecal continence will be monitored by close follow up of the patient either on ward or on an out-patient basis.

Second Group: Patients with essentially intact nervous system, undergoing rehabilitation treatment, and who for various reasons could not retain the contrast material during X-rays examination using standard methods including injections of Valium and Glucagon. Both in- as well as out-patients will be accepted in this study. The study will be performed in close cooperation with the Department of Radiology, New York University Medical Center.

Third Group: Patients with a central nervous system disorder, undergoing rehabilitation treatment, who were unable to retain the barium enema during x-ray examination for abnormal pathology.

FINDINGS TO DATE: In this project the externally placed electrodes were used exclusively. The stimulating current characteristics are as follows:

Frequency:	500 Hertz
Voltage:	0-20 Volts
Impulse:	square, bipolar
Impulse duration:	0.5 miliseconds

Easy fatigability of the anal sphincter muscle was noticed when the impulse duration was shorter than 0.5 miliseconds. Discomfort of the patients during actual stimulation was eliminated by increasing the frequency to 500 Hertz.

The method proved to be safe, relatively easy to apply and control. There were no failures in barium enema examinations in 22 patients, eleven of whom presented a severe central nervous system disorder. All these patients were unable to retain the barium enema during previous examinations using standard methods rendering this extremely important and simple diagnostic procedure useless. Two cancers of the colon were detected. They escaped diagnosis during prior examinations including biopsy.

APPLICABILITY: It is expected that the development of proper anal sphincter stimulation technic can be of enormous help to the debilitated patient as well as instrumental in barium enema examinations in those patients who cannot retain the contrast material.

018 Feedback Control Systems for the Paralyzed

Principal Investigator:	**Warren Frisina, B.E.**	
Status:	**Continuing**	
Dates:	**October 1975-September 1980**	
Cost:	**Annual $34,883** **RT Annual $30,315**	**Projected Total $190,000** **RT % of Annual Total 87%**
Annual Report Reference:	**#16, Page 107, R-96**	

OBJECTIVES: As regards physical interaction with the environment, the human body can be considered a feedback control system. For example, the body subconsciously adapts to walking on an incline. Paralysis blocks necessary information transfer for adaptation. This project intends to supply some of that information especially for cases of severe paralysis by substituting one or more artificial elements for the non-functioning biological counterparts.

METHODOLOGY:

1. Particular controlled elements will be selected.*
2. Feedforward control elements, i.e., myoelectric with attendant training methods and instrumentation, will be interfaced with the above.
3. Feedback control elements, i.e., to produce pressure and proprioceptive sensation, will be interfaced with the above
4. The population sample will include quadriplegics and others suffering from paralysis (sensory and/or motor).
5. Evaluation criteria will include formal interdepartmental participation as well as consumer groups.
6. Sequence for each controlled device:
    1. Set controlled device priority.
    2. Map likely control sites on body.
    3. Establish tentative training methods.
    4. Interface patient with feedforward elements.
    5. Combine "1" and "4" above.
    6. Develop feedback elements.
    7. Combine "3" and "6".
    8. Revise where necessary.
    9. Combine "1", "4" and "6".

* See RT-1 projects R-82 and R-59.

FINDINGS TO DATE: Results include for myoelectric applications to high level quadriplegia. Acceptable control sites (six patients) over areas of the frontalis, upper and middle trapezius and temporalis muscles. Other sites found acceptable for subjects individually were located in areas over the platysma, lower trapezius and masseter muscles.

For EEG applications to high level quadreplegia (one normal subject, three trials), real time correlation was noted between an EMG of the arm (finger extensors) and the corresponding site on the motor strip of the brain.

APPLICABILITY: Findings will aid the high level quadriplegic and other paralyzed individuals by enabling them to become more independent. Functional use of feedback control systems and attendant devices will help free them from constant human attendant care, facilitate finding employment in a suitable vocation, and improve quality of lifestyle by providing additional means of interacting with the environment.

New York University Medical Center

019 Development of Transfer Devices for High Quadriplegic Patients

Principal Investigator:	**Robert G. Wilson, M.S.**	
Status:	**Continuing**	
Dates:	**October 1975-September 1978**	
Cost:	**Annual $29,186** **RT Annual $25,854**	**Projected Total $88,000** **RT % of Annual Total 89%**
Annual Report Reference:	**#16, Page 244, R-97**	

OBJECTIVES: The aim of this project is to develop a transfer device for a high quadriplegic patient. The development consists of the following phases:

1. Careful investigation of present equipment.
2. Designing, developing and testing small-scaled mock-up models of a transfer device.
3. After careful selection of one of the mock-up models, the full size working model will be fabricated.
4. Testing of different patients on the model.

METHODOLOGY:

1. Physical examination of a high quadriplegic patient including range of motion, remaining muscle power and thorough skin check up.
2. The patient will use a full size working model which initially is manually and later power operated. At first, the patient will use it in various areas of the Institute, and later, in his house.
3. Design and development of the transfer device to meet the patient's need.
   a. Fabrication of the final full size model
   b. The model electronically self-controlled by the patient
   c. If the patient is unable to use the electronically controlled model, a mechanically controlled model could be operated with minimum physical effort by a helper regardless of his strength and size.
4. An evaluation questionnaire will be filled out by each patient. Based on the patient's answers, further modifications of the model will be determined.

FINDINGS TO DATE:

1. On October 10, 1975 the first samples of the transfer device, i.e. small models and drawings were shown to the Regional Advisory Committee. They agreed that research and construction of these devices was of great importance and should be continued.
2. On March 10, 1976 the same and some additional models of a transfer device as above were presented to the Patient Advisory Board at New York University Institute of Rehabilitation Medicine.

   There was a discussion whether a highly sophisticated electronic self-controlled (by the patient) transfer device for a high quadriplegic patient should be continued — or whether to concentrate our efforts on the development of a simple mechanical device which could be controlled by one helper with minimal physical effort, regardless of the size of helper or patient.
3. It was agreed upon that it would be more practical to work on the simpler device first. A portable, mechanically controlled (by one helper) transfer device is being constructed now and will soon be patient tested.
4. Working on the above project it was found that the following devices for transfer would be a logical progression to meet more needs of the severely disabled:
   a. A self sliding transfer device built into a wheelchair would aid a high quadriplegic to move to a toilet from the wheelchair and back.
   b. Lightweight cart handled by an attendant would carry a quadriplegic up and down stairs easily.
   c. Special built-in device would aid a wheelchair to climb over a curb or several steps.
   d. Modifications of a conventional wheelchair would aid a quadriplegic in transfer to enter an automobile easily.

APPLICABILITY: The proposed device is also urgently needed by patients with severe and/or multiple disabilities other than spinal cord injuries, e.g. patients with involvement of all four extremities and trunk resulting from poliomyelitis, arthritis, multiple sclerosis, muscular dystrophy, etc. Since many of these patients can perform many daily activities much easier in the wheelchair than in bed, this device would provide at least some independent functioning.

020 The Diagnosis and Remediation of Deficits in Visual Information Processing and Verbal Abstraction in Brain Damaged Adults

Principal Investigator:	**Leonard Diller, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1975-December 1980**	
Cost:	**Annual $159,019** **RT Annual $49,097**	**Projected Total $807,000** **RT % of Annual Total 31%**
Annual Report Reference:	**#16, Page 175, R-92**	

OBJECTIVES: To develop and validate a normative scale and calibrated neuropsychologic module for the differential diagnosis of remediation and prognosis of dysfunctions of visual information processing in various types of brain damaged adults. This will further result in the development of a toxonomy of deficits of visual information processing found in brain damaged adults. These objectives may be broken down in terms of the objectives for each of four sub-studies to be carried out in three years.

METHODOLOGY: This study aims to improve abstract thinking and higher order visual information processing (simultaneity and successiveness) in unilateral brain damaged adults. Each of these aims is pursued through a series of studies involving: (1) the development of criteria for abstract thinking and visual information processing in normals; (2) gathering normative data on hemiplegics; (3) piloting remediation techniques on a small sample of patients; (4) a study in which experimental groups receive training in abstract thinking or visual information processing and controls do not, to see if treatment can impact the criteria. Subjects for abstract thinking will include 48 normals, 48 hemiplegic patients for normative purposes and 60 patients to form experimental and control groups. For the VIP study, 60 normals will be used, 45 hemiplegics will be used for normative purposes and 34 patients will participate as experimentals or controls.

FINDINGS TO DATE: During the past year 52 normals (age 45-75) were administered the test battery enumerated below. This was done in order to standardize the battery and derive a set of age appropriate norms. The battery has also been administered to 23 (13 left and 10 right) hemiplegics. 22-37 Additional hemiplegics will be seen during the next several months in order to complete the standardization process. Following this approximately 4 months will be devoted to pilot studies in training, commencing next spring with the start of the full blown training experiment.

Test Battery
Full WAIS
Conditional Cancellation (developed by Staff)
Embedded Figures (Ayers)
Cube Analysis (Stanford - Binet)
Perceptual Analysis and Synthesis (Birch & Lefford, 1965)
Autobiographical Statement (developed by Staff)
Parts of the Ravens (selected by Staff)
Parts of the Letter (selected by Staff)
Goldstein Object Sorting Task
Visual Simultaniety (developed by Staff)
50 Visual and Pictorial Similarities (developed by Staff)
Trail Making (Part of Reitan Battery)
Knox Cube
Porteus Mazes
Symbol - Symbol (Jastak)
Visual Digit Span
Bender-Bestalt
Metropolitan Achievement Test (Comprehension and Arithmetic)
Simultaneous Recognition (Developed by Staff)
Paragraph Titles

Impersistence
DSS

APPLICABILITY: Hemiplegia constitutes the largest physical disability group with an estimated prevalence of 200-2,000 per 100,000. Our previous studies have indicated that perceptual disorders common to right brain damage are critical bottlenecks in successful rehabilitation (Diller, et al.) (Lorenz & Cancro).

021 Factors Underlying Improvement in Respiratory Function Following Cervical Cord Injury

Principal Investigator:	**Francois Haas, Ph.D.**	
Status:	**New**	
Dates:	**August 1976-July 1979**	
Cost:	**Annual $60,059** **RT Annual $59,059**	**Projected Total $190,000** **RT % of Annual Total 98%**
Annual Report Reference:	**#16, Page 216, R-98**	

OBJECTIVES: The object of this study is to quantify the patterns of improvement in several different areas of respiration and to assess the role played by each of several factors which may promote improvement from the onset of a traumatic cervical cord injury until stabilization occurs. These include studies on (1) the effects of loss of sensation from the rib cage on the reflex ability to regulate ventilation (sensory studies), (2) the factors which lead to improvement in respiration throughout the clinical course (motor studies), and (3) the effects of sensory and motor dysfunction on the ability to maintain effective blood gases and acid-base balance (blood gas studies).

METHODOLOGY: In order to accomplish these goals the following tests have to be carried out. These tests are noninvasive and are designed to produce a minimum of discomfort to the patient and start as close to the time of injury (the best time to be at the inception of the rehabilitation program) as possible and continue for a period of 3 years. First at monthly monitoring, and then every three months. A base line pulmonary function test using either the Goddard Twin Bell Spirometer or the CIP Pulmolab will be carried out at the admission of the patient to the study, and then twice yearly. In addition, the following physiological measurements for each of the other areas of investigation are planned:

I. Sensory Studies

The methods used in the sensory studies involve strictly non-invasive techniques. Patients inspire in the supine position through a J-valve and expire into the atmosphere. The inspiratory limb contains a pneumotachograph to record air flow and a pressure transducer to monitor mouth pressure. Tidal volume is obtained by electronic integration of the flow signal. Samples of expired air are delivered to a capnograph to monitor end-tidal CO_2

Each patient's respiratory resistance and elastance are measured. The anticipated tidal volumes under load conditions are computed from a first order linear differential equation assuming a sinusoidal inspiratory pressure waveform. Deviations between observed and calculated values of tidal volume are used to deduce reflex or mechanical alterations in inspiratory pressure during the loaded breath.

The experimental groups studies thus far have been chosen to include a range of lesion levels (from T-3 to C-4) and ages (13 to 40) to determine the effect of lesion level and age on respiratory performance.

II. Motor Studies

The methodology of this part of the project requires noninvasive measurements obtained at bedside. These measurements include: (1) vital capacity and its subdivisions from a spirometer, (2) rib cage stabilization from chest pneumograms during different breathing maneuvers, (3) respiratory compliance from a weighted spirometer bell to produce a change in lung volume at FRC, (4) peak inspiratory pressure against a closed shutter to determine the isometric pressure generated by the diaphragm, and (5) neurological improvement obtained from physical examination.

Each new patient has these measurements made once monthly and an attempt will be made to correlate these results with age, sex, and level of lesion.

III. Blood Gas Studies

(1) For the blood gas and acid base balance, the Astrup Micro method will be used as described by Segal and Anderson. The capillary blood was chosen to avoid the use of arterial puncture, and possible complications (this test is as accurate as arterial). This test should be given monthly in the early stages and every three months in the latter stages.

(2) Chest stability, sighing and respiratory compliance data will be obtained from measurements in Motor Studies. (See above Motor Study Methods 2 and 3).

FINDINGS TO DATE:

I. Sensory Studies

Data, coupled with an additional separate line of evidence, have eliminated rib cage instability as the cause of the impaired tidal volume stabilization. Thus, RT-1 has been the first laboratory to quantify the respiratory dysfunction resulting from the interruption of thoracic sensory pathways. This study has now been accepted for publication by the Journal of Applied Physiology.

Loaded breathing experiments have been performed in a large group (n=140) of naive normal subjects to define a set of standards applicable to patient population. Data indicate the consciously mediated change in inspiratory motoneuron output play an important role in the immediate response to added loads in untrained subjects. As a result, the "normal" response to added loads has a much greater degree of variability than is currently believed and previously published "normal" responses represent only one point on a continum of possible responses. These results are being compiled so that a realistic standard can be employed to interpret data obtained in quadriplegic patients.

In a series of single breath resistive loads in 8 additional cervical cord subjects, interpretation of of results still remains uncertain - dependent upon results obtained in a control group of 140 normal subjects. It does appear, however, that two different receptor types combine collectively to determine respiratory rate in cord-injured subjects. Additional experiments are planned.

II. Motor Studies

Motor studies were temporarily curtailed to design and construct a special set of rib cage calipers which enable accurate recordings of changes in the rib cage antero-posterior diameter and also to develop a new measurement technique which enables accurate determination of isometric pressures generated by the diaphragm while simultaneously attenuating any possible artifacts resulting from mouth suction. In view of these setbacks, researchers have been unable to study the effects of resistive diaphragmatic exercises in quadriplegic subjects.

However, a study of the effects of a 6-week program of diaphragmatic breathing against abdominal weights ranging from 15-50 lbs. in 20 healthy normal subjects measured 3 different aspects of inspiratory muscle function: (1) maximal shortening, (2) maximal isometric pressure, and (3) maximal velocity of shortening. No measureable improvement was found in any of these parameters resulting from the use of abdominal weight exercises in healthy subjects. However, all subjects studied improved their endurance during these exercises and discomfort associated with exercises waned progressively.

III. Blood Gas Studies

Baseline pulmonary function tests were performed on thirteen patients with cervical spine injuries, ranging in level from C3 to C7. In eight cases pulmonary function tests were done in both sitting and supine, in the remaining only supine tests were performed.

Of the eight, seven showed significantly improved spirometric values of lung function in the supine position. This was probably due to reduction in functional residual capacity and consequently increased in inspiratory capacity. Six of the eight also showed marked improvement in both peak expiratory flow and mid-expiratory flow. The two in whom flows were better in the sitting position were those who had injuries older than three years.

In seven of the above group blood gas analysis were done in both the sitting and supine position. In four of these, PaO_2 was higher in the supine position, one showed no difference and the two with the oldest injuries had PaO_2 that were significantly higher sitting compared to supine.

APPLICABILITY: Results from this study should facilitate:

(1) Ones ability to plan a more appropriate and realistic vocational rehabilitation program, because of increased accuracy of knowledge of nature and extent of deficit, particularly with

respect to potential energy resources;

(2) Less interruption from respiratory problems of an ongoing vocational rehabilitation training program resulting in more efficient use of the program's resources; and

(3) Reduced hypoxemia providing greater energy resources and mental acuity for the patient.

022 Quantification of Electromyography with Computer Analysis

Principal Investigator:	**Arthur Eberstein, Ph.D.**	
Status:	**New**	
Dates:	**December 1977-December 1980**	
Cost:	**Annual $44,907** **RT Annual $38,459**	**Projected Total $140,000** **RT % of Annual Total 88%**
Annual Report Reference:	**#16, Page 124, R-24**	

OBJECTIVES: The objective of this proposal is to advance the state-of-the-art of clinical procedures commonly employed in the diagnosis of neuromuscular diseases: electromyography and conduction studies in motor and sensory nerve fibers. Specifically we are proposing a program which will accomplish the following aims within the framework of the electrophysiological examination:

1. more accurate evaluation of recorded data so as to enhance and validate diagnostic information.
2. application of more sophisticated data analysis techniques.
3. statistical manipulation of blocks of patient data for comparison and longitudinal studies.
4. sharing, comparing and correlating our patient data bank and data analysis routines with other institutions.

METHODOLOGY: Quantitative analysis of EMG signals.

1. Based on work done by Lindstrom using the Fourier transform.
2. Via spectral analyses using surface electrodes.
3. Study of polyphasic potentials.

FINDINGS TO DATE: None to date.

APPLICABILITY: It is the objective of the proposed project to establish a system of computerized analysis of the electrical activity associated with muscle and nerve pathophysiology in neuromuscular diseases. An on-line system will be conceived not only for analysis of the characteristics of motor unit potentials but also for the other electrophysiological events.

University of Minnesota (RT-2)
Medical Rehabilitation Research and Training Center

CORE AREAS

Neuromuscular
Studies of causes, effects, responses and adaptations related to injury or impairment of function of prolonged duration in the neuromuscular system.

Psychosocial-Vocational
Programs on problems in the psychological, social or vocational areas which relate to ability to adapt or respond to the requirements of normal living.

Cardiac Rehabilitation
Activities which communicate research findings of cardiac, pulmonary and vascular requirements for activities throughout the range of normal performance and especially related to adaptation to the requirements of normal living following pathological changes.

Health Care Delivery
Health needs and the efficacy and efficiency of various modes of health services in relation to rehabilitation.

Education in Rehabilitation
Needs, applications, adaptation and modifications of education related to rehabilitation.

Bionomic Adaptation
Methods for responding to or compensating for losses or impairments of interaction with the environment which increase the capacity for performance or the quality of life of the chronically ill or handicapped patient.

Ergonomics
The quantitative evaluation of muscular force, work, power and energy of man.

Spinal Cord Injury
Problems arising in rehabilitation and adaptation to living including community integration in patients who have suffered spinal cord injury.

UNIVERSITY OF MINNESOTA

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

	ABSTRACT NO.
The Evaluation of an Automated Training System for Wheelchair Push-ups (A. Roberts, Ph.D.)	023
Evaluation of Efficacy of Rehabilitation Programs (F.J. Kottke, M.D.)	024
An Atlas of Vocational Histories of Persons with Spinal Cord Injuries (N. Crewe, Ph.D.)	025
An Evaluation of the Relationship of Self-Care Outcomes to Care in the Acute Hospital, the Rehabilitation Center, and to Post-Discharge Level of Function in Stroke Patients (K. Sperling, M.D.)	026
Validity and Reliability of the Health Accounting Method of Quality Assurance in a Rehabilitation Setting (T.P. Anderson, M.D.)	027
A Study of the Golgi Tendon Organ in Human Muscles and Tendons (R. Bistevins, M.D.)	028
The Value of LDH Isoenzyme Studies in Collagen Disease (A.T. Ozel, M.D.)	029
The Effect of Cervical Orthoses on Cervical Spine Motion: A Standardized Radiographic Method of Study (S. Fisher, M.D.)	030

CONTINUING

Studies of Urologic Function in Patients Following Spinal Cord Injuries (M. Price, M.D.)	031
Study of Cardiac Work Evaluation and Reconditioning After Myocardial Infarction (W.G. Kubicek, Ph.D.)	032
Quantitative and Qualitative Evaluation of Muscular Hypertonia in Patients with Central Nervous System Disease (D. Halpern, M.D.)	033
Study of the Changes in the Structure, Ultrastructure, Innervation and Enzymes of Skeletal Muscle in Neuromuscular Diseases (E. Awad, Ph.D.)	034
Training Program for Upper Extremity Activities in Athetoid Patients (D. Halpern, M.D.)	035
Quantitative Studies of Muscular Strength and Muscular Work (M. Mundale, R.P.T.)	036
A Followup Study of the Psychological, Social and Vocational Adjustment of Spinal Cord Injured Adults (G.T. Athelstan, Ph.D.)	037

University of Minnesota

Voluntary Control of Autonomic Processes Using Biofeedback and Reinforcement Procedures (A.H. Roberts, Ph.D.) 038

An Investigation of Decubitus Ulcer as a Manifestation of a Psychological Problem (T.P. Anderson, M.D.) 039

Bibliography of Psychosocial, Vocational, and Sexual Aspects of Spinal Cord Injury (G.T. Athelstan, Ph.D.) 040

Behavior Modification: A Problem-Oriented, Learning-Based, Research Strategy for Rehabilitation (J. Martin, Ph.D.) 041

Followup Study of Patients Treated in the Pain Treatment Program, Physical Medicine and Rehabilitation Service, University of Minnesota Hospitals (A.H. Roberts, Ph.D.) 042

Effective Training in Rehabilitation Medicine in New Medical School Curriculum (F.J. Kottke, M.D.) 043

NEW

A Functional Limitation Scale for Rehabilitation Evaluation (N. Crewe, M.D.) 044

A Method of Measuring Some Patient Characteristics, Goals, Results, and Costs of Medical Rehabilitation (T.P. Anderson, M.D.) 045

An Investigation of the Cause and Prevention of Ischemic Ulcers (R. Patterson, Ph.D.) 046

DISCONTINUED

Treatment of Obesity in a Medical Rehabilitation Setting: An Interdisciplinary Approach to Weight Loss and Maintenance

PROPOSED

Social Skills Training for Young Adults with Cerebral Palsy

Energy Cost, Blood Pressure and Heart Rate Studies During Sexual Intercourse

Study of Heating of Deep Muscle by Short Wave Diathermy

A Radiographic Study of the Restriction of Spinal Mobility Using Thoracolumbosacral Orthoses

Self-Concept As a Factor in the Rehabilitation of a Physically Disabled Population

Study of the Responses of the Urethral Sphincters, Detrusor of the Bladder, and Anal Sphincter by Electromyography and Air Cystometrography during Stimulation of the Anus and Rectum in Patients with Spinal Cord Injury

023 The Evaluation of an Automated Training System for Wheelchair Push-ups

Principal Investigator: **Alan H. Roberts, Ph.D.**
Status: **Completed**
Dates: **July 1971-June 1977**
Cost: **Annual $30,520** **Projected Total $60,000**
RT Annual $21,395 **RT % of Annual Total 70%**
Annual Report Reference: **#16, Page 241, R-34**

OBJECTIVE: To develop a small, light, inexpensive, and reliable battery operated device which will fit in the wheelchair, and signal patients to remind them to perform a wheelchair push-up; ideally the apparatus will also include a numerical counter to count the number of push-ups performed during a specified period of time.

METHODOLOGY:

1. The apparatus is comprised of a pressure switch, timer, counter, and sound-emitting device. The timer is set to sound a buzzer unless the patient raises himself from the wheelchair at least once during the set period of time. If he does so before the device is activated, the timer will reset. The counter automatically tabulates the number of pushups done by the patient.
2. Paraplegic patients will be assigned randomly to one of two groups; the experimental group will use the apparatus while the control group will be equipped with a counter and timer without a warning device. The number of pushups done by the two groups over a given period of time will be compared.
3. Followup data will be obtained to determine whether the training that occurred by use of the device will continue after the device is removed. Techniques will be developed to allow changing from regular to irregular reinforcement schedules to promote generalization of learned habits beyond the hospital.

FINDINGS TO DATE: The current testing status of the prototype device suggests that it performs satisfactorily and appears to be working well in pre-tests with patients. A device to count the number of wheelchair push-ups is still being developed since it presents engineering problems that have not yet been fully solved. The apparatus necessary for the project to carry out its methodology has been developed. The device is being tested on suitable patients as they become available on the Rehabilitation Service. Efforts at improving the sensing system of the wheelchair push-up counter are still going on. Dynacon is the material being tested. A slight modification has been made to the Control Subject data recorder. A channel indicating elapsed time of 60 to 90 minutes between push-ups was sacrificed for a channel indicating the total time that the subject was out of the chair.

APPLICABILITY: Skin breakdowns are quite common in patients who have not established patterns, before they leave hospital, of doing pushups independently of reminders. A method to help patients establish the habit of doing pushups would reduce a major cause of morbidity in spinal cord injured patients.

024 Evaluation of Efficacy of Rehabilitation Programs

Principal Investigator: **Frederic Kottke, M.D.**
Status: **Completed**
Dates: **March 1972-September 1977**
Cost: **Annual $74,605** **Projected Total $460,000**
RT Annual $50,955 **RT % of Annual Total 68%**
Annual Report Reference: **#16, Page 248, R-44**

OBJECTIVES:

1. To collect data on patients in the major problem categories of rehabilitation medicine for the period since 1949 from the records of the University of Minnesota Rehabilitation Center;

2. to analyze status on admission and discharge, and quantitative change in the function of various parameters;
3. to analyze the adjustments to the community after discharge;
4. to obtain data on survival, financial status, vocational, and social adjustment;
5. to analyze effects of kind, amount, and duration of rehabilitation services; and
6. to test recommended management programs on patients.

METHODOLOGY: A computer program has been developed for entry of critical information. The data entered include pertinent demographic data, diagnosis, problem lists, methods of treatment including physical therapy, occupational therapy, speech therapy, vocational evaluation, ortheses and prostheses, and special treatments. The major entries have now been made. The program is being tested and missing information is being supplied so that computer runs can be made for selected factor analysis of the various categories of patients or problems.

FINDINGS TO DATE: The remaining demographic, diagnostic, therapeutic, and outcome data was prepared for computer processing. Computer problems have caused delay in processing data. Further studies using this computerized data will be carried out under R-68 and other projects.

APPLICABILITY: Evaluation of the efficacy of rehabilitation procedures and programs of management is essential to place rehabilitation medicine on a sound scientific base and to establish the current state of rehabilitation against which newly proposed methods may be compared.

025 An Atlas of Vocational Histories of Persons with Spinal Cord Injuries

Principal Investigator:	**Nancy Crewe, Ph.D.**	
Status:	**Completed**	
Dates:	**July 1973-September 1977**	
Cost:	**Annual $16,490** **RT Annual $14,891**	**Projected Total $38,570** **RT % of Annual Total 90%**
Annual Report Reference:	**#16, Page 256, R-48**	

OBJECTIVES:

1. To provide a reference tool, a collection of histories of successfully employed quadriplegics and paraplegics, to aid in the vocational rehabilitation of persons with spinal cord injuries;
2. to provide a publication for vocational counselors on the adjustment process for spinal cord injured clients, counseling techniques, and extensive lists of sedentary jobs; and
3. to provide a publication on vocational rehabilitation of spinal cord injured persons to researchers and academicians.

METHODOLOGY:

1. The literature relating to employment with spinal cord injury will be reviewed.
2. A large number of persons with spinal cord injury who might be able to contribute to the project will be identified.
3. Potential subjects will be surveyed by mail to determine which persons are employed.
4. An interview schedule which explores many aspects of working including preparation, job seeking experiences, employment duties, satisfactions and frustrations, problems and solutions will be developed and pretested.
5. All subjects who live within a reasonable distance, approximately 200 miles, of University Hospitals will be personally interviewed at home.
6. The original sample will be augmented with the assistance of other research and training and spinal cord injury centers.

7. Out-of-state subjects who are working in jobs not represented in the Minnesota sample will be interviewed by telephone using the same interview schedule.
8. Case histories which combine biographical, psychological, and medical data with a detailed description of the employment achieved by the subjects will be written.
9. All sedentary, indoor jobs listed in the "Selected Characteristics of Occupations" supplement to the "Dictionary of Occupational Titles" will be identified.
10. Several chapters integrating information available in the literature and data gathered through this project will be written.
11. A book for spinal cord injured persons entitled **Possibilities: Employment After Spinal Cord Injury** will be written and published.
12. A handbook for counselors on the employment of spinal cord injured persons will be written.

FINDINGS TO DATE: During this year the manuscript for the **Atlas of Vocational Histories** was submitted to the University of Minnesota Press. The editor suggested that the manuscript be divided, and thus a new manuscript for spinal cord injured people, **Possibilities: Employment After Spinal Cord Injury**, has been prepared and submitted to a commercial publisher. Work is beginning on the two remaining publications.

APPLICABILITY: Persons with spinal cord injuries, particularly quadriplegics, share severe functional limitations. So many activities are unavailable that a basis for bringing about a more positive focus in vocational counseling is needed. Since so many quadriplegics and paraplegics are youthful accident victims, the importance of finding some productive outlet for their time and talent is an important, if not essential, aspect of rehabilitation.

026 An Evaluation of the Relationship of Self-Care Outcomes to Care in the Acute Hospital, the Rehabilitation Center, and to Post-Discharge Level of Function in Stroke Patients

Principal Investigator:	**K. Sperling, M.D.**	
Status:	**Completed**	
Dates:	**October 1973-September 1977**	
Cost:	**Annual $56,274** **RT Annual $45,864**	**Projected Total $221,000** **RT % of Annual Total 82%**
Annual Report Reference:	**#16, Page 260, R-52**	

OBJECTIVES:

1. To assess the changes in self-care improvement patterns for stroke patients with respect to the patient's contact with the rehabilitation center and the health care institution, and with respect to his post-discharge level of functioning;
2. to evaluate nursing staffing patterns and cost factors of different rehabilitation programs to see whether these factors have a significant influence upon self-care improvement patterns for differentiable subgroups of stroke patients;
3. to investigate post-discharge placement as it relates to self-care improvement levels.

METHODOLOGY: The tasks to be carried out under this project have been segmented as follows:

1. Baseline data will be collected on stroke patients treated in three health care facilities with contrasting rehabilitation.
2. Followup data will be collected on a subsample of these patients at points 6 and 18 months following discharge from primary hospitalization.
3. Data analysis will be performed.

FINDINGS TO DATE: The preliminary findings are as follows:

1. Impact of length of stay on improvement in self-care ability is little at St. Francis, mild at Northwestern and high at Sister Kenny Institute.

2. Comparison of treatment at acute facilities and Sister Kenny Institute is being done through review of treatment histories.
3. An analysis of the nursing staffing data revealed that the two acute hospitals averaged 5.2 hours, while Sister Kenny Institute averaged 7.3 hours.
4. Patients living at home remain at higher self-care levels than those in nursing homes.
5. A comparison was made between the acute hospitals and the tertiary center, matching patients on the variables of Time Since Onset and Admission Self-Care Score.

APPLICABILITY: The results of this study may initiate changes in pre-and post-rehabilitation care. If certain stroke management practices in current use are of greater benefit than others, then changes should evolve in the management of stroke rehabilitation at various levels of patient care.

027 Validity and Reliability of the Health Accounting Method of Quality Assurance in a Rehabilitation Setting

Principal Investigator:	**Thomas P. Anderson, M.D.**	
Status:	**Completed**	
Dates:	**October 1975-September 1977**	
Cost:	**Annual $32,955** **RT Annual $20,368**	**Projected Total $50,000** **RT % of Annual Total 65%**
Annual Report Reference:	**#16, Page 268, R-59**	

OBJECTIVES:

1. To consolidate and analyze previous health accounting experience;
2. to evaluate procedural reliability and validity;
3. to examine the impact of health accounting strategy on improving the quality of care;
4. to test the generalizability of the protocol to a rehabilitation outcomes study other than completed stroke;
5. to improve the efficiency of the protocol by incorporating recommendations of the first study team;
6. to institutionalize the protocol by orienting and involving a greater number of department personnel.

METHODOLOGY: The first three objectives will be studied in the following manner. A medical sociologist will analyze the documents, manuals, and forms, and taped discussions of project participants. He will then make recommendations for improving project procedures and instruments. Three new project resources are being developed. The ten care settings will evaluate the validity and reliability of specific health accounting procedures. They will examine priority setting of health topics, outcomes standard setting, and reliability of the outcomes measurements made by the health accountant. The Johns Hopkins staff will analyze and draw conclusions from data from all ten care settings. Participating clinics will be matched with nonparticipating clinics to test the development of a measure of innovativeness.

The last three objectives, carried out only by the University of Minnesota, fulfill the requirement that three topics be studied during the project. An exclusive study team will be selected for each topic, thus involving new department personnel.

FINDINGS TO DATE:

1. Three health problems were chosen for study:
   a) Education for Urinary Tract Infections in Spinal Cord Injured Patients;
   b) Therapeutic Program to Retain Function in Employment Aged Patients with Chronic Low Back Pain; and
   c) Intermuscular Neurolysis and Motor Point Blocks by Physicians on Inpatients and Outpatients with Spasticity. Several new personnel were oriented and study was begun.
2. The coordinator attended a medical coordinators seminar on the future design and procedural development for completing the outcomes assessment projects.

3. The initial outcomes assessment on Urinary Tract Infections in Spinal Cord Injured Patients was completed. The actual outcomes were far below those expected. Problems contributing to these are: patient-related, environment-related, and staff-related.
4. The actual outcomes of the low back pain patients interviewed came close to the estimated standards except for the two lowest levels on the Williamson's Function Impairment Scale.
5. The initial outcomes assesment on intermuscular neurolysis for inpatients and outpatients with spasticity was begun.
6. Several recommendations were made by the study team.

APPLICABILITY: An improved and refined system for assessing rehabilitation will 1) focus on outcomes, 2) develop a standard definition of outcomes, and 3) apply to all areas of rehabilitation. Both health professionals and patients will benefit by improved treatment and lower costs of rehabilitation.

028 A Study of the Golgi Tendon Organ in Human Muscles and Tendons

Principal Investigator:	**Rita Bistevins, M.D.**	
Status:	**Completed**	
Dates:	**September 1975-June 1977**	
Cost:	**Annual $52,234** **RT Annual $44,477**	**Projected Total $60,000** **RT % of Annual Total 85%**
Annual Report Reference:	**#16, Page 281, R-61**	

OBJECTIVES:

1. To study the microscopic structure of the GTO in man;
2. to study the ultrastructure of the GTO in the human by electron microscopy;
3. to study the innervation of the GTO in man;
4. to study the localization of the GTO in man;
5. to study the electrophysiological response of the GTO in man to motion and stretch.

METHODOLOGY: Preliminary work on tissue specimens from autopsy material will establish the technique of localization of the GTO, as well as its gross appearance and structure. Biopsy specimens will be taken from normal muscles from patients undergoing surgical procedures. Localization of the GTO will be attempted by teasing the biopsy specimen under a dissecting microscope and searching for this structure. The tissue will be fixed in formalin, embedded in paraffin and sectioned. The slides will be stained: for hematoxylin and eosin to study the general structure and appearance; silver impregnation to demonstrate the nerve endings and the nerve fibers; and other possible stains as the need may arise. An attempt will be made to study the electrical response of the GTO to motion and/or stretch of the muscle or its tendon, thus stimulating activity in the muscle. A high gain electromyograph will be used for this purpose. This will be carried out on patients with poor muscular control.

FINDINGS TO DATE: The structures of 158 sensory end organs were studied. Of the 126 end organs identified, 111 were paciniform corpuscles and 13 were Golgi tendon organs. Two structures could not be classified in either group. Five sensory receptors were studied with electron microscopy. Of these two paciniform corpuscles were serially sectioned. One Golgi tendon organ and one Meissner corpuscle from a human fingertip were also examined.

APPLICABILITY: Disorders of motor function such as paresis and paralysis with or without spasticity are frequently seen in rehabilitation patients. Better understanding of factors contributing to reflex regulation of motor function is needed. The data resulting from this project will lead to better understanding of the motor behavior and control of muscular motion. This will, in turn, lead to development of better techniques for therapy.

029 The Value of LDH Isoenzyme Studies in Collagen Disease

Principal Investigator:	**A. Turkyilmaz Ozel, M.D.**	
Status:	**Completed**	
Dates:	**September 1976-September 1977**	
Cost:	**Annual $30,527** **RT Annual $24,198**	**Projected Total $24,200** **RT % of Annual Total 79%**
Annual Report Reference:	**#16, Page 287, R-65**	

OBJECTIVES: To determine the relationship between the activity of rheumatoid arthritis and other collagen diseases and the change in the LDH isoenzymes.

METHODOLOGY: Blood will be drawn from patients during the very acute stage of a collagen disease. LDH isoenzymes will be determined by electrophoresis. When a needle biopsy is necessary for diagnostic purposes the tissue will be studied. It will be processed for: electromicroscopic examination of ultrastructure; hematoxylin and eosin staining to demonstrate the structure of the muscle fibers and their nuclei; trichrome staining to evaluate the connective tissue elements in muscle; and chemical microanalysis to determine the change in LDH isoenzymes in the tissue. When aspirational joint effusion is necessary for diagnostic purposes or treatment, LDH electrophoresis will also be done in joint effusion. The results will be compared to investigate the relationship between the activity of collagen diseases and the change in LDH isoenzymes.

FINDINGS TO DATE: During the past year, LDH isoenzymes have been determined by electrophorosis on more than 100 blood samples from 73 patients with rheumatoid arthritis, scleroderma, systemic lupus erythematosis, and dermatomyositis. LD-3 isoenzyme was found elevated in 68 patients who have been in the active stage of their diseases. In patients who have been followed, LD-3 isoenzyme has fluctuated according to the activity level of the disease. In 5 patients who were in the inactive stage of their diseases, LD-3 isoenzyme was found to be within normal limits.

LDH isoenzyme studies on loose connective tissue have shown that these tissues give exclusively LD-3 isoenzyme. In all 4 loose connective tissue samples studied by electrophorosis, 100 percent of the LDH isoenzymes was purely LD-3. LDH isoenzyme studies were done with human fibroblast and human lymphocytes. Neither one showed a big LD-3 value. On the other hand, synovial tissue obtained from 2 monkeys and 2 humans gave high LD-3 values.

These findings have supported the original hypothesis that a definite LD-3 isoenzyme occurs during the course of rheumatoid arthritis and other collagen diseases and that this change in LD-3 isoenzyme probably reflects the degree of activity of the disease. The source of LD-3 isoenzyme was obscure until recently. This study has clearly shown that the main source of LD-3 isoenzyme is the connective tissue.

APPLICABILITY: Since arthritis may be disabling, its effects on the economy are significant, not only in terms of employment, but also support. Prevention of deformities and disabilities in collagen disease depends on early diagnosis and appropriate treatment. LDH isoenzyme studies seem to have a potential value both in the early diagnosis and the followup of the treatments. Prevention or even delay of disabilities in rheumatoid arthritis and other collagen diseases will certainly make it possible for some of the patients to continue, or return to, their previous jobs.

030 The Effect of Cervical Orthoses on Cervical Spine Motion: A Standardized Radiographic Method of Study

Principal Investigator:	**Steve Fisher, M.D.**	
Status:	**Completed**	
Dates:	**September 1975-March 1977**	
Cost:	**Annual $6,300** **RT Annual $938**	**Projected Total $9,100** **RT % of Annual Total 15%**
Annual Report Reference:	**#16, Page 292, R-66**	

OBJECTIVES:

1. To study the effects of cervical orthoses on the range of motion of the cervical spine in flexion and extension;
2. to study the range of motion at each given intervertebral level from T1 to the skull in different types of cervical orthoses to obtain data on which orthosis best stabilizes at each individual cervical spine level; and
3. to compare the radiographic and bubble goniometer method of measuring cervical range of motion.

METHODOLOGY: Young adults, ages 20 to 30, served as subjects. Each was fitted and studied in several types of cervical orthoses:

1. SOMI orthosis
2. Peterson orthosis
3. Jewett J-21 orthosis
4. SOMI orthosis with chin strap

Each individual was fitted by a certified orthotist. Pressure transducers were placed under the chin piece and occipital piece. Each subject was instructed to flex and extend the neck to a given pressure recording. Cervical sagittal spine films were obtained in the neutral flexion and extension position without a cervical orthosis and in each of the orthotic devices. Bubble goniometric data was also obtained. The data was evaluated by using previously described methods of radiographic measurement.

FINDINGS TO DATE: This project has been completed. The four-poster and SOMI^R orthoses best immobilized the cervical spine. The average sagittal motion of O-CI was 11° and total CI-C2 motion 14°. The statistical correlation between the bubble goniometer method and each of the x-ray measurement methods on unrestricted cervical spine motion was fair to good. When the SOMI^R orthosis was fitted at a "lower" resting pressure, there was no statistically significant difference in the restricted sagittal plane cervical spine motion.

APPLICABILITY: The data of this study can directly be used in the proper prescription as well as fitting of cervical orthotic devices in various pathological conditions. It is suggested that perhaps orthotists should use pressure sensors when fitting braces to obtain the best fit possible within tolerable pressure limits.

031 Studies of Urologic Function in Patients Following Spinal Cord Injuries

Principal Investigator:	**Mary Price, M.D.**	
Status:	**Continuing**	
Dates:	**October 1963-October 1978**	
Cost:	**Annual $160,155**	**Projected Total $890,000**
	RT Annual $110,035	**RT % of Annual Total 69%**
Annual Report Reference:	**#16, Page 5, R-2**	

PART I

OBJECTIVES:

1. To study renal function and micturition and their relationship to recurrent bladder infection in patients with spinal cord injury;
2. to test methods for improvement of urinary bladder function and management in patients with spinal cord injury;
3. to record the changes of urinary tract function of paraplegic and quadriplegic patients over a period of time.

METHODOLOGY:

1. Renal function is tested by blood and urine analyses after intravenous injection of insulin and para-amino hippurate.
2. The mechanism of urination is studied by gas cystometry, clinical analysis, and radiographic techniques. In catheter-free patients, the amount of urine remaining in the bladder after voiding is measured.
3. Urine culture results and the patient's history of bladder infections are correlated with the findings of the preceding studies.
4. Prediction of the control of bladder contractility is attempted through the use of the urecholine denervation super-sensitivity tests.
5. Data from testing is available for patient information and major statistical analyses.

FINDINGS TO DATE:

1. Sister Kenny Institute patients have withdrawn from this project because of staffing and transportation difficulties.
2. With the approval of the Federal Drug Administration the Renal Function Laboratory was chosen by Arnar-Stone Laboratories to compare the efficiency of the modified form of inulin with the older form of inulin in testing glomerular filtration rate. The two substances compared closely with each other. The FDA has approved the inulin and inulin clearance testing has resumed throughout the United States.
3. Four hundred and ninety patients have been tested to date.

APPLICABILITY: Preliminary reviews of systematic, ongoing evaluations of spinal cord injury, indicate that urinary tract deterioration is not inevitable and that funds spent in training patients' physicians, paramedical personnel, and the families of patients in their proper care will result in a great saving of funds formerly spent as a result of the treatment of physical and psychological deterioration.

PART II

OBJECTIVE: To determine change of renal function in paraplegic and quadriplegic patients who have required ileac diversion and compare these changes with spinal cord injured patients who have not required ileac diversion.

METHODOLOGY: Studies of renal function as outlined in Part I are carried out immediately before diversion and annually thereafter.

FINDINGS TO DATE: A doctoral thesis is being prepared that will demonstrate that while the mean value of annual rate of change of the total population of our study shows slight improvement of function annually, the mean value for annual rate of change of patients with ileac diversions is somewhat better than the mean value of the entire group. Regression lines showing change of function prior to diversion in comparison with change of function after ileal diversion are being prepared. The doctoral candidate preparing the results was forced to postpone the completion of his work.

APPLICABILITY: The surgical procedure, ileac diversion, is being more frequently performed to avoid kidney deterioration resulting from poor kidney drainage. There is need for objective evidence regarding the efficacy of this procedure.

PART III

Discontinued

PART IV

OBJECTIVE: To compile a comprehensive bibliography of the world literature concerning the urinary tract function of patients with spinal cord injury, emphasizing especially the pathophysiology of the urinary tract, laboratory methods for diagnosis, therapeutic approaches and statistical methods of documentation.

METHODOLOGY: Medline is being used to search major medical indices. Primary reference cards are made for 71 subtropics with cross referencing. These have been catalogued.

FINDINGS TO DATE: As of June, 1977, 13,500 references are filed, with an additional 9,275 cross references and 13,875 authors listed. Members of the laboratory have read 7,000 of the references.

APPLICABILITY: Through the bibliography it has been possible to improve research techniques and to apply therapeutic findings to patient treatment.

PART V

OBJECTIVE: To accumulate data for future study of the relationship of immunological processes to urinary tract infection.

METHODOLOGY: Electrophoretic patterns of serum proteins are obtrained for each patient receiving a urinary tract evaluation. Antibody coating determinations have been requested with selected urine cultures.

FINDINGS TO DATE: Preliminary reports indicate some abnormality of electrophoretic pattern in more than one fourth of the patient tests. Twelve percent showed decreased total serum protein. In the globulin fraction the greatest number of abnormalities was found in Alpha 2, followed by Gamma, Alpha 1, and Beta, in that order. Current efforts are being made to correlate the abnormalities found with evidence of upper-tract infection as indicated by calyceal blunting.

APPLICABILITY: Since urinary tract infections are prevalent in patients with spinal cord injuries, treatment of these infections, aided by the determination of immunological changes in the blood, would significantly aid in the rehabilitation and maintenance of rehabilitation of these patients.

PART VI

OBJECTIVE: To document changes in bladder contractility through the use of the Merrill Gas Cystometer.

METHODOLOGY: The gas cystometer is used to record changes in bladder pressure of weekly or bi-weekly intervals for inpatients and at the time or return visits by outpatients.

FINDINGS TO DATE: One hundred seventy-eight gas cystometrograms were made, together with 13 denervation and supersensitivity tests, utilizing Urecholine between June, 1976 and May 1977. The gas cystometrogram was used for education for trial of voiding for 30 patients during this same period.

APPLICABILITY: The results of this story will aid in improving patient care through the more accurate assessment of the value of cholinergic and symphatomimetic drugs in augmenting or depressing bladder contractibility, through the determination of length of period of spinal shock, through predictions of the success of trials of voiding, and through the correlation of the level of spinal cord injury with the changes of pattern contractility.

PART VII

Discontinued

PART VIII

Discontinued

PART IX

OBJECTIVES:

1. To assess the efficacy of a telescopic double lumen catheter in minimizing contamination of urine obtained for culture from the ileal conduit;
2. to establish a reliable method for obtaining urine cultures from patients with ileac diversions.

METHODOLOGY: Urine is obtained for culture by inserting a double lumen catheter into the ileal conduit and by sterile swab from the stoma.

FINDINGS TO DATE:

1. A telescopic double lumen catheter has been used to obtain urine speciments from 116 patients with ileac diversions. Urine culture from the ileal loops of 47 patients showed no growth; 69 cultures showed growth with from 1 to 5 different species of microorganisms: 36% of positive urine cultures grew more than one organism. Urine cultures from the loops of 45 patients showed no growth, even though the stoma swab from the same patients indicated the presence of up to 7 different species of microorganisms on the area surrounding the opening to the loop.
2. These studies indicate that the double lumen catheter method of obtaining urine culture specimens presents a reliable method of determining ileal loop infection and avoids the possibility of contamination as the catheter is inserted through the stoma.
3. This procedure has been incorporated into routine procedures for evaluating the renal function of patients with ileac diversions.
4. Results indicate that improper care of the ileostomy and appliance is a possible source of infection because bacteria may be introduced into the ileal loop and subsequently to the kidneys from a contaminated stoma or collection bag. An illustrated manual was prepared after

observation of patient care, both in and out of the hospital, indicating the need for a more explicit educational program for both patients and attendants.

APPLICABILITY: The use of the double lumen catheterization procedure may provide a method of obtaining urine specimens free from contamination as the catheter is inserted through the stoma.

PART X

OBJECTIVES:

1. To study the sources of urinary tract infections in patients with ileac diversions;
2. to determine the extent of bacterial flora present in the ileal loop at the time of diversion and to establish if this bacterial flora plays a part in subsequent infections;
3. to determine if post diversion infections are related to prediversion urinary tract infections;
4. to determine possible sources of postdiversion reinfections.

METHODOLOGY:

1. Aerobic and anaerobic cultures are made from a section of the ileal wall and both ureters at the time of ileac diversion. Urine cultures are made before the operation and serially following the operation.
2. Antibiotic sensitivity tests are made on all organisms present and organisms are saved for future study.

FINDINGS TO DATE: Between June, 1976 and May, 1977, 24 patients with current urinary tract infections exhibiting no fewer than two organisms isolated by urine culture have been followed since before their diversions. At the time of diversion cultures were made from sections of the ileum (12 had bacterial growth, 12 did not), the right ureter (11 had bacterial growth, 10 did not and 3 were not cultured), and the left ureter (8 had growth, 13 had no growth and 3 were not cultured.)

APPLICABILITY: The incidence of bacteriuria in spinal cord injured patients with ileac diversion has remained high. It is important to evaluate the possible reasons for this high incidence of bacteriuria and to establish procedures of care and medical management that will help eliminate urinary tract infection.

PART XI

OBJECTIVE: To determine the predictable normal annual variation of glomerular filtration rate, renal plasma flow, and tubular excretion of individual patients.

METHODOLOGY: A least-squares regression line is plotted using successive test values following the third evaluation of each patient.

FINDINGS TO DATE: Following the publication of a doctoral thesis, results of the analysis will be available. The mean annual variation for Glomerular Filtration Rate is 9 ml/M^2/min, for Renal Plasma Flow 90 ml/M^2/min, and TmPAH 5 ml/M^2/min.

APPLICABILITY: This study will provide the first documented data regarding the yearly fluctuations of function. This knowledge will provide physicians with guidelines for assessing the clinical importance of changing rates of glomerular filtration rate, renal plasma flow, and tubular excretion in a given patient.

PART XII

OBJECTIVES:

1. To implement a program of patient instruction and training in the care of the urinary tract and urinary collecting devices, emphasizing the importance of maintaining optimal kidney function from the beginning of acute care of the patient following spinal cord injury;
2. to assess the understanding of the patient regarding urinary tract care prior to his leaving the hospital;
3. to assess the value of this program in preventing urinary tract infections and in maintaining renal function by comparing information obtained at periodic followup of these patients with data from patients not exposed to this program.

METHODOLOGY:

1. Educational material has been prepared and will be given to each spinal cord injured person after admission to the hospital.
2. The staff will check off, date, and sign each subject after it has been discussed.
3. The patient will be tested before discharge. Any remedial education necessary will be done at that time.

4. An effort will be made to include families and attendants in the educational program.

FINDINGS TO DATE: The materials for this patient education program have been developed.

APPLICABILITY: A patient who has adequate understanding of his urinary tract and the methods of caring for it will have less medical-hospital expense and morbidity. The patient will benefit financially, socially, and vocationally.

032 Study of Cardiac Work Evaluation and Reconditioning After Myocardial Infarction

Principal Investigator:	**William G. Kubicek, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1972-October 1981**	
Cost:	**Annual $236,705** **RT Annual $179,375**	**Projected Total $750,000** **RT % of Annual Total 76%**
Annual Report Reference:	**#16 Page 36, R-5**	

OBJECTIVE:

1. To study the hemodynamic parameters involved after acute myocardial infarction;
2. to study the response of the damaged heart to exercise and stress testing at mild and moderate energy expenditure in early post-myocardial infarction patients;
3. to investigate correlation of the electrocardiograph changes and the cardiac function as recorded from the impedance cardiograph during exercise stress testing in the early subacute stage, at 21 days, and after 3 months or more; and
4. to determine whether the Impedance Cardiograph and electrocardiograph monitoring of graded exercise tests can be used to establish the safe level of patient performance and progressively test the patient until he or she has demonstrated adequate physical capacity to leave the hospital.

METHODOLOGY:

1. The Minnesota Impedance Cardiograph and a multilead electro-graph are used to monitor patients exercising at various levels of exertion, ranging from mild exercise in the early convalescent phase to moderately strenuous bicycle ergometer or treadmill exercise in the post-discharge period.
2. Calculations from the wave forms are made for stroke volume, caridac output, and parameters related to cardiac contractility.
3. A laboratory for cardiac and metabolic function has been installed at the University of Minnesota Hospitals. This laboratory provides research capability for complete cardiac and metabolic evaluation. The laboratory has the following list of equipment:
   a. an automated Medical Systems PFA-5 mass spectrometer system for metabolic function analysis,
   b. a model 304A impedance cardiograph,
   c. a Quinton-Monark model QI-870 electrically controlled bicycle ergometer,
   d. a Quinton model 18-49-CI electrically controlled treadmill,
   e. a Gould model 2400 three-channel analog recorder for use with the impedance cardiograph,
   f. Gould model 481 eight-channel analog recorder for use with mass spectrometer system,
   g. Physio-Control series 70DC defibrillator,
   h. Marquette automatic electrocardiograph model 3300, and
   i. Decwriter connected via telephone with UCC for the input of data into computer storage and calculations.
4. The impedance cardiograph continues to be compared to other methods of measuring cardiac function. The mass spectrometer has been calibrated to a degree that exceeds the accuracy needed to measure physiological functions.

APPLICABILITY: Problems directly involving the heart can be studied and the status of the patients more accurately assessed, using the Minnesota Impedance Cardiograph. Another field of use is monitoring the amount of fluid in the chest or lungs, such as in congestive heart failure. The third major use of this system is in peripheral vascular disease. Therefore, any doctor treating these patients would have use for the Impedance Cardiograph. The mass spectrometer system is useful for these patients, especially those with cardiopulmonary diseases.

PART I

OBJECTIVE: To determine that cardiac output measured by impedance cardiography and ECG during exercise testing in the rehabilitation phase after myocardial infarction can predict current status and future function better than the prediction from ECG alone.

METHODOLOGY: The Minnesota Impedance Cardiograph was used as a separate test for the function of the heart during exercise. Simultaneously, a program of analyzing ECG, target pulse rate, and clinical symptoms was used separately. The patients were categorized into one of four classes using the Functional and Therapeutic Classifications of Patients with Diseases of the Heart (American Heart Association).

FINDINGS TO DATE: Sixty-five coronary care patients were tested. The 34 patients who passed both tests were in a better clinical condition than those who failed one or both tests. Patients who failed both tests should have exercise programs prescribed for them with care. The patients who failed one of the tests do not have as good a future outlook as the patients who passed both tests. This portion of the project is completed.

APPLICABILITY: These data provide a very valuable basis for the prediction of the social and employment status of patients following a coronary infarction. A test of this type will be of great help to the physician attempting to evaluate the remaining heart function following the damage of the infarct.

PART II

OBJECTIVES:

1. To determine ZCG standards for normal males of average size for cardiac output and contractility index in response to a steady state of exercise from 2 METs through 6 METs;
2. to determine a practical, reproducible method of measureing basal oxygen consumption;
3. to determine the time required to reach steady exercise state from resting state;
4. to determine the time required to return to the pre-exercise resting state; and
5. to observe any training effect on repeat testing.

METHODOLOGY: Ten normal male subjects between 19 and 24 years of age and of average height and weight underwent measurement by mass spectrometry of basal oxygen consumption (1 MET) under standardized conditions. Over several days they exercised on a treadmill at 2 METs through 6 METs with monitoring of heart rate, EKG, minute oxygen consumption and ZCG. They also performed a submaximal exercise test up to 80 percent of maximal heart rate for age according to the schedule of Bruce.

FINDINGS TO DATE: Part II of the research project has been completed. The results yield the following information to date:

1. Values closely approximating presently accepted basal oxygen consumption were achieved under our standardized, but practical conditions at 265 cc/min/1.93M^2 body surface area.
2. Cardiac output during sitting, fully supported rest was slightly higher than that at 2 METs through 6 METs the curvilinear mean heart rate and stroke volume were almost mirror images, producing a linear mean cardiac output increase which at 6 METs was 145 percent of basal and 160 percent of the 2 MET value. Comparison of the two trials revealed no significant training effect.
3. Stroke volume was highest in the semireclining sitting position which augmented venous return. Stroke volume leveled off at 5 METs.
4. Heart rate and stroke volume are mutually reciprocally inter-reactive so that neither alone shows a linear relation to cardiac output.

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5. The myocardial contractility index of Heather shows a linear increase at activities greater than 2 METs.
6. The standard deviation of these values is approximately ± 15 percent.

Standards were determined for: 1) comparison of caridac output and contractility indices during steady state exercise, 2) the time required to reach the steady state from resting state at the various levels of exercise and the time required to reach the pre-exercise resting state from steady state exercise, and 3) a setting in which oxygen consumption can be measured that favorably compares to well-known and accepted basal metabolic rates.

APPLICABILITY: Normal standards of comparison obtained under conditions simulating the exercise testing conditions of the nonmyocardial infarction patients will enhance the interpretation of ZCG data.

PART III

OBJECTIVES:

1. To establish an individualized cardiac rehabilitation program;
2. to determine the usefulness of ZCG and ECG monitoring of graded exercise tests in establishing safe levels of patient performance;
3. to determine whether tested progression results in a shorter stay than the standard program; and
4. to determine whether short term rehabilitation restores the patient to vocational activity as fast as the standard program.

FINDINGS TO DATE: Twenty-four acute myocardial infarction patients were referred for a Cardiac Rehabilitation Program. Some patients were discharged on the tenth to the fourteenth day after their myocardial infarctions. The program was individualized.

PART IV

OBJECTIVES:

1. To introduce, establish normal limits for, and show the usefulness of a cardiac rehabilitaiton program based on cardiac oxygen consumption as indicated by the heart rate blood pressure product; and
2. to test convalescing cardiac patients to determine relative cardiac stress of activity using heart rate blood pressure method.

METHODOLOGY: Healthy subjects and cardiac patients were tested while doing homemaking, occupationally related, recreational, and calisthenic activities. Instantaneous measurements of blood pressure, pulse, electrocardiogram, total oxygen consumption, and other ventilatory parameters were taken.

FINDINGS TO DATE: We are as yet only in the planning stage for the experimental research described previously. The laboratory is now organized and we are attempting to evaluate various methodologies to improve on the present setup.

APPLICABILITY: The objective measurements of stress of various activities in cardiac patients may allow patients to return to work earlier, and will give vocational counselors and cardiologists a more definitive means of deciding when a patient may safely resume vocational activities.

PART V

OBJECTIVE: To determine the efficacy of measuring by a noninvasive method, the mechanical pumping action of the heart in patients undergoing surgery for a coronary bypass, to attach an electrical pacemaker to the heart, or undergoing heart valve surgery for either commissurotomy or prosthesis.

METHODOLOGY: Impedance cardiograph studies will be made on patients with electrically paced hearts, undergoing aorta-coronary artery bypass surgery, and heart valve surgery for either commissurotomy or prosthesis. Each patient will be studied pre- and postsurgery and followup observations will be made.

FINDINGS TO DATE: A pilot study of a patient who had a surgical attachment of a pacemaker has been done.

PART VI

OBJECTIVES:

1. To determine the accuracy of using treadmill grade and speed as a measure of the work level performance of cardiac patients undergoing a progressive exercise stress test;
2. to determine whether the addition of metabolic parameters will improve the sensitivity of the progressive stress test to detect coronary artery disease;
3. to objectively evaluate the work level change of coronary artery bypass surgery patients; and
4. to determine whether metabolic parameters will be useful in determining which patients will benefit most from an exercise rehabilitation program.

METHODOLOGY:

1. The actual work level as determined by the oxygen uptake will be measured and then compared with the value predicted by various tables.
2. The data obtained by the ECG and metabolic parameters will be compared with the results obtained by angiography or other events such as myocardial infarction or death due to heart disease.
3. The work performance of patients pre- and postcoronary artery bypass surgery will be evaluated using the metabolic parameters.
4. The metabolic parameters will be correlated with improvement in work performance that occurs on an outpatient exercise program.

FINDINGS TO DATE: Preliminary results in our laboratory show that a patient's predicted work level, based on treadmill speed and grade, may be in error in some cases, by a factor of 2 compared to the actual work level based on oxygen uptake measurements.

APPLICABILITY: If the progressive stress test can more effectively evaluate patients, physicians can advise patients regarding employment more confidently and can evaluate coronary artery bypass surgery more effectively.

PART VII

OBJECTIVE: To develop a low-cost, small, portable device to monitor the exercise level of patients in the cardiac rehabilitation program.

METHODOLOGY: A device will be developed to monitor the heart rate and emit a signal that will indicate deviations of the heart rate from some preset level. A second phase of the development will detect arrythmias.

FINDINGS TO DATE: A device has been designed that can monitor the heart rate and give a signal indicating deviations of the heart rate for some preset limits. The preliminary prototypes have been used by actual patients. The study on the impedance and offset potential of disposable ECG electrodes was studied. With the sanding of the skin, the low cost electrode would give as good a performance as the more costly electrodes. Stainless steel electrodes should not be used because they tend to polarize with small DC currents. The electrodes were also drying out before use, as they were packaged in large numbers. The patient trigger level control is also causing problems. Efforts will be made to develop an automatic control.

APPLICABILITY: A small, portable, low-cost device that can give audio feedback about the physiological level of exercise seems to be ideal to carry out an exercise program for a cardiac patient.

033 Quantitative and Qualitative Evaluation of Muscular Hypertonia in Patients with Central Nervous System Disease

Principal Investigator:	**Daniel Halpern, M.D.**	
Status:	**Continuing**	
Dates:	**August 1964-July 1979**	
Cost:	**Annual $50,268** **RT Annual $38,669**	**Projected Total $265,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#16, Page 72, R-6**	

OBJECTIVES:

1. To develop an apparatus and system to objectively evaluate the character of abnormal muscle tone and the alterations of tone accomplished by various procedures; and
2. to analyze abnormal muscle tone and evaluate therapeutic procedures.

METHODOLOGY: The analytic system is based on the current neurological concept that the muscle spindle, a sensory organ within skeletal muscle, responds to two parameters of elongation, the amount of stretch, and the velocity of the movement. Recordings are made of the force applied and electromyographic activity during a standardized series of passive movements imposed at velocities varying from 3° to 150° per second. Analysis of the data yields quantitative information in the form of a numerical value of the related physical parameter. This system also allows quantitative study of central nervous system activity giving rise to dystonic states that are not mediated by the fusimotor system. By carrying out an analytic procedure that specifically identifies the responsiveness of the skeletal muscle to lengthening and to the velocity of length, not only can these two elements be identified and measured, but the influence of other sources of tone may be measured as well.

FINDINGS TO DATE: During the year 1975-1976, the construction, assembly, and testing of an electrohydraulic automated drive apparatus continued. The capability of rigid velocity control will enable better correlation with other workers in the fields of rehabilitation and neurophysiology, will make examination procedure less arduous, and will enable the examination of the large muscle groups of the upper and lower limbs of a greater number of adults. Since the forces necessary to provide the velocity range required are quite high, considerable engineering time has been required to provide safety devices and precautions against patient or staff injury. Interdepartmental cooperation on this project has been provided by the Hydraulics Laboratory of the University of Minnesota Institute of Technology and the Biomedical Computer Sciences Center. The revisions of the program instituted in 1974 have been utilized for the continued evaluation of patients who have been subjects of various therapeutic procedures.

A total of 197 examinations were carried out in 1976-1977. Since June 1976, 43 patients were examined multiple times. Nine patients were examined in connection with stereotactic brain surgery or cerebellar stimulation for the treatment of dystonia. Twenty-three patients were examined to evaluate the effectiveness of medication on hypertonia, seven of which were treated with L-dopa, and two patients were examined to evaluate the effect of intramuscular neurolysis. Twenty-nine patients were examined and used as controls; three patients were tested for reflexes.

APPLICABILITY: At the present time many procedures for the treatment of patients with muscular hypertonia are being carried out, with little more than subjective judgments as to their validity and continued usefulness. Evaluation of each of these treatment techniques would provide a solid scientific basis for their use, and the objective measures would be worthwhile. Treatment of patients with central nervous system disease would be rendered more effectively, less wastefully, and more economically.

University of Minnesota

034 Study of the Changes in the Structure, Ultrastructure, Innervation and Enzymes of Skeletal Muscle in Neuromuscular Diseases

Principal Investigator: **Essam Awad, Ph.D.**
Status: **Continuing**
Dates: **September 1969-October 1979**
Cost: **Annual $62,421** **Projected Total $300,000**
RT Annual $52,152 **RT % of Annual Total 84%**
Annual Report Reference: **#16, Page 91, R-8**

OBJECTIVES:

1. To study the histopathologic changes occurring in disabling neuromuscular diseases;
2. to study the electrophysiological changes in the neuromuscular system;
3. to study the changes in enzyme activity in these muscles;
4. to identify the specific cause of muscular weakness in individual patients;
5. to improve diagnostic criteria for the neuromuscular diseases that are seen in rehabilitation;
6. to study the ability of human muscle to regenerate as seen in samples taken from patients since the beginning of the project; and
7. to review all the biopsies and enzyme levels of blood samples collected since the beginning of the project.

METHODOLOGY: Patients are evaluated by history, physical examinations, clinical laboratory tests as indicated, and electromyographic and nerve conduction studies. Histopathology of muscle and terminal nerve endings is studied by performing a motor point biopsy to sample the involved muscle(s) and its nerve. The tissue is then processed for: electron microscopic examination of ultrastructure; vital staining with methylene blue to determine the changes in the branches of the intramuscular nerve and the motor end-plates; PAS staining to demonstrate glycogen; toluidine blue staining to demonstrate acid mucopolysaccharides; hematoxyline and eosin staining to demonstrate the structure of the muscle fibers and their nuclei; trichrome staining to evaluate the connective tissue elements in muscle; chemical microanalysis to determine any abnormal constituents in the tissue; review of the biopsy material; and determine the stage of growth or maturation and changes of the cells.

FINDINGS TO DATE:

This project, thus far, has produced two significant findings.

1. Increased LDH isoenzyme activity, particularly LDH^3 was found to be diagnostic of fibrositis. This finding has never been reported or known before. The Archives of Physical Medicine and Rehabilitation has published an article on the increase of LDH isoenzyme activity as an indicator of fibrosis.
2. Satellite cells were found in all muscles sampled in different age groups. This is an indication of the ability of human skeletal muscle to regenerate. Because of the complexity of the process of regeneration the investigators feel that a separate project is needed to identify the possible stimuli for muscular regeneration in the disabled.

During the past year, the following conditions have been under study:

1. Collagen disease – fifty-eight patients
2. Neuropathy – eight patients
3. Interstitial fibromyositis – seven patients
4. Muscular dystrophy – two patients
5. Unidentified muscle weakness – four patients
6. Normal – nine patients

APPLICABILITY: The muscular weakness of many disabled individuals is not clearly understood and needs to be clarified by this research approach, otherwise their rehabilitation will not be complete. As the cases accumulate, the data is analyzed in terms of populations with specific disabilities and their characteristic findings. After studying enough cases in depth, definite conclusions may be drawn that will enable the practicing physicians to identify and analyze the patient's disability and place the patient in the proper perspective.

035 Training Program for Upper Extremity Activities in Athetoid Patients

Principal Investigator:	**Daniel Halpern, M.D.**	
Status:	**Continuing**	
Dates:	**September 1965-July 1979**	
Cost:	**Annual $68,630** **RT Annual $59,829**	**Projected Total $245,000** **RT % of Annual Total 87%**
Annual Report Reference:	**#16, Page 98, R-14**	

OBJECTIVES:

1. To develop an experimental design and technology to evaluate therapeutic method used in cerebral palsy that will be specific enough to measure difference between methods;
2. to identify elements of neuromuscular function that are important in the development of manual coordination;
3. to test the effectiveness of specific component procedures presently available to develop improved coordination in upper extremities of athetoid patients;
4. to develop a series of procedures to train manual coordination, based on neurophysiologic concepts of motor learning that have been shown experimentally to have therapeutic validity;
5. to develop, by using quantitative evaluation techniques for motor coordination, a method that identifies the specific limitations, or the level of coordination that represents a maximum level of performance in an athetoid patient.

METHODOLOGY: Adult patients acted as their own controls. The effectiveness of the training methods was tested by comparing rates of learning during a given time period. Evaluation was done by attaching battery powered small lights to the hand, wrist, and arm of the patient. Still photographs were then taken by a camera with the shutter open. The resulting data indicated direction, range, tortuosity, regularity of rate, and speed. Half of the group was scheduled into an EXPERIMENTAL-CONTROL-EXPERIMENTAL training sequence, and the other half into a CONTROL-EXPERIMENTAL-CONTROL sequence. More accurate observations were made in this way. The photographic data was recorded by computer. During this past year, the table that allowed electromechanical digitization of the localization of the coordinates of the projected image was constructed, standardized, calibrated, and made operational.

FINDINGS TO DATE: A preliminary analysis of the **Inhibition** and **Control** manual skill training programs, described in last year's report, was done. The **Inhibition** program was inferior to the **Control** program, but the **Control** program was more effective when it followed the **Inhibition** program. Learning occurred in both training programs. A methodologic and theoretical approach has been developed to deal with variable individual performance in a way that can arrive at meaningful conclusions in a natural clinical setting. Using "best" scores rather than a mean, and increments of improvement in "best" scores have been productive in increasing validation in selecting the optimum treatment. The results of previous studies can now be calculated in a total objective manner by using computer programs. Some components, such as tortuosity and velocity control, still need further study to achieve objective evaluations. Computer programs have been established to measure these values for each test performance and convert them to the scoring system for the parameters of motion previously established. These analyses have been completed. Two remaining studies in this project are the evaluation of effectiveness of training of Desynthesized Kinesiologic Components of Motion and the evaluation of the Therapeutic Concepts of Margaret Rood.

APPLICABILITY: The public, the medical profession, the rehabilitation therapies, and the education profession are engulfed in a morass of opinions, relating to all systems of therapy for cerebral palsy. A clear definition of valid therapeutic principles would improve the function of handicapped patients, relieve the frustrations of their families, prevent wasteful expenditure, and provide a common realistic body of thought among professionals. The identification of the feedback parameters and sensory avenues for monitoring performance that are most effective for motor learning should be a direct consequence of an extended series of investigations using this procedure.

036 Quantitative Studies of Muscular Strength and Muscular Work

Principal Investigator:	**Martin Mundale, R.P.T**	
Status:	**Continuing**	
Dates:	**August 1963-September 1979**	
Cost:	**Annual $42,986** **RT Annual $759**	**Projected Total $230,000** **RT % of Annual Total 2%**
Annual Report Reference:	**#16, Page 114, R-18**	

OBJECTIVES:

1. To develop standardized testing procedures for the major muscle groups;
2. to establish normal values for age and sex;
3. to make meaningful estimates on how much weakness a patient has relative to an adopted norm;
4. to evaluate the deviation of fatigability and endurance from expected normalcy;
5. to evaluate the muscular function of patients prior to surgery and therapy and to evaluate strength and endurance; and
6. to provide experience for medical students, medical residents, and physical therapy students in quantitative methods employed to evaluate strength and endurance.

METHODOLOGY: Transducers and electronic recording equipment are used to test the strength of various muscle groups. Testing has been standardized for hip flexion, hip extension, knee flexion, knee extension, ankle plantar flexion, elbow flexion, elbow extension and hand grip. Development of techniques for testing other muscle groups are still under study.

FINDINGS TO DATE: Six patients with dermatimyositis have been followed for from one to four years, comparing quantitative muscular strength with clinical evaluation and laboratory measures of systemic inflammation. The following studies are in progress: Procedure for Testing Ankle Plantar Flexion and Norms Established, Procedures for Testing Handgrip Force and Norms Established, Comparison of Grip Strength and Grip Endurance During Isometric Exercise, Kinesiology of Hip Extension, and Voluntary Maximal Torque.

APPLICABILITY: Precise, quantitative techniques for measuring muscular strength during isometric contraction make it possible to localize neurologic deficits and quantitative muscular weakness and to follow the effects of treatment. Repeated measurements of strength are used to monitor the patient's status during treatment which aids in deciding the treatment program.

037 A Followup Study of the Psychological, Social, and Vocational Adjustment of Spinal Cord Injured Adults

Principal Investigator:	**Gary Athelstan, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1973-June 1978**	
Cost:	**Annual $37,847** **RT Annual $28,142**	**Projected Total $125,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#16, Page 125, R-47**	

OBJECTIVES:

1. To gather and analyze descriptive data pertaining to the psychological, social, and vocational adjustment of spinal cord injured adults;
2. to develop and define categories of rehabilitation outcomes, including non-vocational outcomes, based upon measures of psychological adjustment;
3. to identify factors relating to rehabilitation outcomes, including such variables as the psychological and social characteristics of spinal cord injured persons and the various treatments they receive, with a special effort to identify variables which can be manipulated to increase the frequency of desired outcomes.

METHODOLOGY:

1. A sample of 301 spinal cord injured adults, who have been injured for at least 2 years, has been identified. All available relevant data on these patients were tabulated and analyzed to describe the persons and evaluate their psychosocial and vocational adjustment and medical status.
2. Indepth interviews were conducted with the spinal cord injured patients and members of their families. Specially designed interview schedules and standardized instruments were used to gather detailed information on the experiences of the subjects and the steps involved in the process of social, psychological, and vocational adjustment to disability.

FINDINGS TO DATE:

1. The initial phases of the project have been completed, with 128 subjects and 66 significant others having been interviewed. The extensive data have been edited, coded, and most analyses finished.
2. The definition of psychological adjustment was broadened to devise a composite measure of productive activities apart from employment in which a severely disabled person might engage.

APPLICABILITY: Since rehabilitation goals tend to be defined in vocational terms, little attention has been devoted to specifying goals for people who need rehabilitation services but have little or no prospect of vocational rehabilitation, including many severely disabled spinal cord injured patients. Specifically designed psychological and social, as well as vocational objectives will aid in focusing the treatment program for persons with spinal cord injuries. Even for those spinal cord injured persons who are not employable, better personal adjustment may carry economic rewards in terms of increased self-care and lower medical costs.

038 Voluntary Control of Autonomic Processes Using Biofeedback and Reinforcement Procedures

Principal Investigator:	**Alan H. Roberts, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1974-June 1979**	
Cost:	**Annual $58,861** **RT Annual $50,136**	**Projected Total $110,000** **RT % of Annual Total 85%**
Annual Report Reference:	**#16, Page 131, R-53**	

OBJECTIVES:

1. To conduct a series of experiments which will provide answers to some questions concerning the voluntary control of autonomic functions, especially skin temperature, and the applicability of autonomic learning to the clinical treatment of disabling disorders associated with dysfunction in peripheral circulation.

METHODOLOGY: Two autonomic reactivity and control scales are administered to subjects. Selected subjects are given a number of baseline tests of autonomic reactivity and control in the laboratory. Subjects selected from the second group are further trained in controlling the temperature of their fingertips. The data from the individual psychophysiological screening sessions on hand-warming are analyzed. The physiological measures are subjected to ANOVA comparisons of two groups at a time. The physiological measures are subjected to factor analysis, yielding five factors.

FINDINGS TO DATE:

1. A paper describing the construction of the Perceived Somatic Response Inventory was prepared for publication.
2. The second phase of the primary study was completed.
3. The study of the effectiveness of skin temperature regulation in controlling the pain of migraine headaches was completed.
4. A study of the role of muscular mediation in autonomic learning using paraplegic subjects was begun.
5. A study to determine the effectiveness of skin temperature regulation in the control of the symptoms of Raynaud's disease was begun.

APPLICABILITY: As a treatment technique biofeedback will not totally supersede any of the current management systems. In its broadest sense, however, it is bound to become a significant tool for practitioners dealing with specific problems or with a particular aspect of rehabilitation. Even in those instances in which the patient cannot sustain the learning from clinic into his or her daily life, technologies are now available and will be developed to provide permanent biofeedback aids to patients that they can use outside of the clinic, either to maintain or improve their levels of performance. Perhaps one of the most significant advantages of biofeedback training to the disabled patient is that giving the performance information directly to the patient allows him or her to assume a more active and responsible role in his or her own rehabilitation process.

039 An Investigation of Decubitus Ulcer as a Manifestation of a Psychological Problem

Principal Investigator:	**Thomas P. Anderson, M.D.**	
Status:	**Continuing**	
Dates:	**September 1975-October 1978**	
Cost:	**Annual $2,444** **RT Annual $2,183**	**Projected Total $44,500** **RT % of Annual Total 89%**
Annual Report Reference:	**#16, Page 149, R-57**	

OBJECTIVES:

1. To develop a measurement of decubitus ulcers that would reflect the impact of their occurrence on the patient;
2. to identify those psychosocial factors associated with the occurrence of pressure sores;
3. to develop a new program for training patients and health care workers in the prevention of decubitus ulcers.

METHODOLOGY: This study has two stages. The first stage attempted to delineate those psychosocial factors that would predispose an individual to the increased probability of skin ulceration. Differences on three psychosocial measures among 141 spinal cord injured, both inpatients and outpatients, were examined along with their history of decubitus ulcers since the onset of their injury. The psychosocial measures used were the Tennessee Self Concept Scale, a self-report measure of the individual's personal satisfaction with his life activities, and a measure of individual responsibility in skin care. Multiple linear regression was used to determine those factors associated with the variance in incidence of decubitus ulcers.

The second stage will utilize the information gathered from stage one to determine the direction, content, and methods of a new education program. This program will be directed at health care workers and patients to decrease decubitus ulcer incidence.

FINDINGS TO DATE: The data gathering, tabulation, and statistical tests have been completed for stage No. 1. The sample is 128 persons who had complete data. There is a difference in decubitus ulcer history among various groups of subjects. Quadriplegics, as a group, had a history of fewer pressure sores. The independent variable that contributed most in accounting for the variance was the satisfaction with the activities of life. The patient education program and the validation of the results of Stage No. 1 are under consideration.

APPLICABILITY: The isolation of some psychosocial aspects of decubitus ulcer incidence will aid in signaling conditions which could predispose a patient to the development of pressure sores. Physicians, DVR counselors, patients and their families can watch for and use these signals.

The development of new programs for teaching skin care hopefully will lower the incidence of decubitus ulcers and their cost.

040 Bibliography of Psychosocial, Vocational, and Sexual Aspects of Spinal Cord Injury

Principal Investigator:	**Gary T. Athelstan, Ph.D.**	
Status:	**Continuing**	
Dates:	**November 1975-January 1981**	
Cost:	**Annual $2,941** **RT Annual $2,941**	**Projected Total $35,855** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 160, R-58**	

OBJECTIVES:

1. To provide a well organized, comprehensive bibliography of all confirmed publications about psychosocial, vocational, and sexual aspects of spinal cord injury;
2. to distribute the bibliography widely, both to justify its development and to facilitate the updating process;
3. to serve as a central contact for the widest possible dissemination of new and existing references to facilitate the rehabilitation service and research in the area.

METHODOLOGY: Letters stating the purpose of the project and requesting copies of any locally produced bibliographies and articles were sent to all regional spinal cord injury centers and member physicians of the American Spinal Injury Association. In addition to the letters, a review of RSA supported research and a standard search of the medical and psychosocial literature was done using the MEDLARS and PASAR computer search systems. The citations in relevant publications were checked and all references were verified. By updating the literature searches every year and including a request for further materials along with the distributed bibliography an up-to-date bibliography will be continually available.

FINDINGS TO DATE: After cross-checking to eliminate duplicated references and those that could not be confirmed, our collection was reduced to 500 separate entries. Each of these was carefully checked for accuracy and to determine authenticity, and a judgment was made about the main focus of the work. On the basis of these judgments, the references were assigned to one or more of four content categories. As a result, we now have approximately 235 references dealing with the psychological aspects of spinal cord injury, 155 with social aspects, 130 with vocational, and 175 with sexual. This total exceeds the count of 500 separate entries because some references provided major treatment of more than one topic and were therefore listed under more than one heading. In addition, because spinal cord injury in sports has emerged as a separate topic of some interest, we developed a cross-index to approximately 40 references under the heading of sports.

Approximately 530 copies of the bibliography have been distributed thus far. Letters of announcement were sent to the following types of organizations and institutions:

Veteran Administration Hospitals and Centers
Research and Training Centers
Regional Spinal Cord Injury Care Centers
Private hospitals designated as rehabilitation or spinal cord centers
Complimentary copies were sent to journals in the rehabilitation field
Brochures were distributed at the book fair at the 53rd Annual Session of the American Congress of Rehabilitation Medicine
Easter Seal Societies
Canadian Paraplegia Association branches
Outstanding researchers in the field: Rusk, Guttman, Comarr, etc.
Svenska Centralkommitten for Rehabilitering
In addition to orders received in response to our notices, we also received inquiries from many individuals and institutions, foreign and American, whom we did not notify.

The first supplement, containing 77 new references has been issued. One hundred and sixty copies of this supplement had been distributed by April 1977.

APPLICABILITY: The rapid growth of spinal cord injury rehabilitation programs, the conceptualization and expansion of the regional spinal cord injury centers, and the concommitant increase in research and theoretical publications make a centralized integration of the diffuse knowledge essential for providing maximally effective utilization for rehabilitation and further research. In its present state the literature on psychosocial, vocational, and sexual adjustment to spinal cord injury lacks any integration or organization. The large number of relevant journals and identification of these articles makes a literature review for research difficult, and the individual professional rehabilitation worker cannot even be aware of the current state let alone new developments. The availability of an organized, current bibliography could greatly enhance the service and research applications of this growing body of literature.

041 Behavior Modification: A Problem-Oriented, Learning-Based, Research Strategy for Rehabilitation

Principal Investigator:	**Jerry Martin, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1976-September 1981**	
Cost:	**Annual $16,519**	**Projected Total $75,000**
	RT Annual $12,233	**RT % of Annual Total 74%**
Annual Report Reference:	**#16, Page 164, R-62**	

OBJECTIVES:

1. To demonstrate the applicability of behavior modification procedures to the improvement of motor functioning of medical rehabilitation patients in physical and occupational therapy;
2. to determine whether rehabilitation therapists can learn to generate treatment programs based on a behavior analysis or precision teaching model;
3. to focus upon the adolescent medical rehabilitation population so that program effectiveness may be reflected in vocational outcomes; and
4. to evaluate the long-term effectiveness of behavior modification on severely handicapped medical rehabilitation patients through reassessment in outpatient followup clinics.

METHODOLOGY: Severely handicapped adolescents with cerebral palsy, closed head injuries, and spinal cord injuries who are hospitalized for medical rehabilitation will be included in this study. Behavior modification will be applied as an adjunct in the treatment of specific motor functioning problems. Short term effectiveness will be evaluated through the use of appropriate single-subject research designs. Long-term effectiveness will be evaluated in outpatient follow-up clinics.

FINDINGS TO DATE: The literature survey is continuing. Six In-Service Training Sessions were held. A series of pilot studies on head control, upper extremity functioning, and ambulation training have been conducted. Two additional aspects of behavior modification, the use of EMG biofeedback as an adjunct in therapy with the cerebral palsied and compliance with medical and therapeutic regimens in rehabilitation medicine, are being explored.

APPLICABILITY: The use of behavior modification in rehabilitation has been limited to a very narrow range of problems. Thus, it is not widely used in comparison to its applications elsewhere. Demonstration of behavior modification effectiveness over a broad spectrum of motor behaviors in the severely handicapped should stimulate other facilities to use these techniques for problems other than management of patient misbehavior.

University of Minnesota

042 Followup Study of Patients Treated in the Pain Treatment Program, Physical Medicine and Rehabilitation Service, University of Minnesota Hospitals

Principal Investigator:	**Alan H. Roberts, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1976-June 1979**	
Cost:	**Annual $53,025** **RT Annual $39,568**	**Projected Total $56,000** **RT % of Annual Total 75%**
Annual Report Reference:	**#16, Page 172, R-63**	

OBJECTIVES:

1. To devise a questionnaire to collect data from all patients evaluated in the pain clinic;
2. to administer the questionnaire and the MMPI to these patients and their spouses 12 months after discharge;
3. to interview these patients regarding their experience with the Pain Clinic and/or Pain Treatment Program;
4. to determine the effectiveness of the Pain Treatment Program;
5. to determine possible improvements in evaluation, selection, and treatment procedures; and
6. to test the hypothesis that patients treated in the Pain Treatment Program will show greater activity, more paid employment or other appropriate work, less drug use, and less use of health care than those rejected or not treated.

METHODOLOGY: A thorough review of the current literature on pain research will be conducted and the research will be coordinated with other pain treatment programs (cf, Projects R-61 and R-63, University of Washington) in order to enhance the use of current knowledge, avoid duplication and coordinate interviews and questionnaires with data being collected at other treatment centers. Approximately 30 patients admitted to the Pain Treatment Program, 30 patients accepted but not admitted, and 30 patients rejected for treatment will be evaluated by means of a questionnaire and an interview with a social worker or psychologist trained in the evaluation of chronic pain problems. They will also retake the MMPI. Spouse or other significant person in their lives will be evaluated when these individuals were evaluated as part of the initial intake assessment.

FINDINGS TO DATE: AT this time, 78 people have been contacted about the followup study by letter. Of these 78, 57 have been contacted by phone. Of those 57, 9 have completed the followup questionnaires and interviews. Two more are scheduled for their interviews, another 41 have agreed to participate and have been sent their questionnaires. One is deceased, and 4 have refused to participate. Of the 5 people (all female) interviewed who are in the "completed program" subgroup, 3 might be termed "successful" in terms of their overall adjustments, their current employment status, their amounts of observed pain behavior, and their levels of drug usage. The "successful" patients are willing to "live with their pain" while the "unsuccessful" patients are still seeking medical solutions to obtain total relief from their pain.

APPLICABILITY: The claims of a high rate of successful treatment in behavior modification of pain programs have often motivated chronic pain patients to undertake the difficult and costly inpatient treatment program. Other patients severely disabled by chronic pain are not being referred to pain treatment programs of this type because success rates have not been clearly documented. Documentation of these data is important for future patients, for referring physicians and for those responsible for paying the costs of inpatient treatment as well as the extremely high costs of chronic pain not successfully treated. Specific factors identified as indicating potential for successful treatment will be useful to physicians, insurance companies, vocational rehabilitation personnel and workman's compensation programs in considering the recommending and financing of such treatment for their patients or clients. Identification of factors predicting unsuccessful treatment will also significantly reduce costs.

043 Effective Training in Rehabilitation Medicine in New Medical School Curriculum

Principal Investigator:	**Frederic J. Kottke, M.D., Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1974-October 1976**	
Cost:	**Annual $4,000** **RT Annual $4,000**	**Projected Total $12,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 178, R-70**	

OBJECTIVES:

1. To determine the extent to which exposure to rehabilitation medicine education experiences during medical school develops an understanding of and positive attitudes toward chronic disease and disability and the role of rehabilitation medicine in meeting the needs of these patients; and
2. to identify the impacts of rehabilitation medicine educational experiences that are likely candidates for inclusion in today's medical school curricula.

METHODOLOGY: This study utilized a retrospective research design intended to take advantage of natural experimental situations and events that have occurred in four medical schools, three with Rehabilitation Medicine (RM) training (experimental schools) and one without. A mail survey was conducted on practicing physicians in the United States who had attended these schools to determine the lasting attitudinal and behavioral effects stimulated by RM exprience in medical school.

FINDINGS TO DATE: Data was tabulated on respondent characteristics, school characteristics, the impacts of RM medical school experiences on behavioral and attitudinal outcomes, behavioral outcomes, and attitudinal outcomes. The degree of exposure to RM during medical school is positively associated with later effective practice behavior in dealing with chronically ill and severely disabled individuals. Further, attitudes toward RM appear to be associated with identifiable RM medical school experiences. Additional analyses will attempt to relate attitudes toward RM with physician practice behavior. We will also make an attempt to assess the impacts of changes of curricula within schools.

APPLICABILITY: Because of the shortage of physiatrists, primary care physicians must become more competent in treating chronic illness and disability. This study is intended to assess the relative effectiveness of those representative combinations of RM educational experiences that are today reasonable candidates for inclusion in changing medical school curricula.

044 A Functional Limitation Scale for Rehabilitation Evaluation

Principal Investigator:	**Nancy Crewe, Ph.D.**	
Status:	**New**	
Dates:	**October 1976-September 1978**	
Cost:	**Annual $47,164** **RT Annual $39,903**	**Projected Total $80,000** **RT % of Annual Total 85%**
Annual Report Reference:	**#16, Page 191, R-67**	

OBJECTIVES:

1. To refine the preliminary version of the Functional Limitations Inventory (FLI) into a helpful tool for rehabilitation counselors;

2. to determine the validity of the scale for predicting vocational outcomes with disabled persons;
3. to evaluate the usefulness of the FLI in classifying severity of disability; and
4. to evaluate the effectiveness of the FLI for grouping patients who present similar rehabilitation problems.

METHODOLOGY:

1. The Pilot phase involves Scale expansion and reliability testing. The following aspects of the scale will be examined: potentially critical assets that may limit the impact of functional limitations; existing coding conventions; preliminary reliability conventions and testing; a new series of interviews; and inter-rater reliability coefficients.
2. The Validation phase will involve counselors from settings other than the University of Minnesota. A large number of subjects will be located. Training programs and materials for participating counselors will be developed. Counselors will complete the FLI on 30 clients and then follow up the clients at specified intervals. The relationship between the FLI and the followup cirterion will be investigated. A manual on the FLI will be developed.

FINDINGS TO DATE: This research project has not been initiated because the investigators had been awaiting the project approval. Work on this project will begin in the Fall of 1977, one year later than originally planned.

APPLICABILITY: Current RSA priorities recognize the need for more adequate definitions of severe disability and measures of functional capacity that will guide the rehabilitation process to optimal physical, psychosocial, and vocational outcomes. Also a need exists for more accurate prediction of vocational rehabilitation outcomes. The FLI has potential bearing on these concerns.

045 A Method of Measuring Some Patient Characteristics, Goals, Results, and Costs of Medical Rehabilitation

Principal Investigator:	**Thomas P. Anderson, M.D.**	
Status:	**New**	
Dates:	**October 1976-October 1979**	
Cost:	**Annual $129,959** **RT Annual $95,275**	**Projected Total $180,000** **RT % of Annual Total 73%**
Annual Report Reference:	**#16, Page 196, R-68**	

OBJECTIVES:

1. To document gains made by patients on a general rehabilitation service as a result of participating in medical rehabilitation programs;
2. to compare goals set at admission with gains made;
3. to assess the functional utility of gains;
4. to measure the durability, after one year, of gains made while in the hospital;
5. to assess the cost of achieving rehabilitation gains; and
6. to apply the method of measuring patient progress to a large number of general rehabilitation patients.

METHODOLOGY: The patient description forms developed in R-45 have been used to obtain data on patients. Data is stored in a computer. Methodology is being developed to collect annual followup data on patients discharged from the Rehabilitation Center.

FINDINGS TO DATE: Work has been done on objectives 1, 2, 3, and 6. The patients from whom data was collected fall into 7 disease categories. The following types of data has been collected and tabulated: demographic; duration of time between onset of disability and admission to the

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rehabilitation service; referral sources; average length of stay on the rehabilitation service; goals listed by the patient and rehabilitation staff at time of admission; admission and discharge status of mobility, self-care, speech and language, vocational adjustment, and psychological adjustment; and changes in measures of these functions between admission and discharge.

APPLICABILITY: As federal priorities focus more and more upon the quality of health care, this project goes a step beyond. Not only will quality of health care come under scrutiny by this project but, more important, the outcome of the health care processes will be clarified. Outcome ultimately is the best measure of goal achievement and cost benefit. For rehabilitation to continue to compete for health care dollars, it must demonstrate that patients are changed in a desirable direction as a result of involvement in the rehabilitation process.

046 An Investigation of the Cause and Prevention of Ischemic Ulcers

Principal Investigator:	**Robert Patterson, Ph.D.**	
Status:	**New**	
Dates:	**July 1977-October 1981**	
Cost:	**Annual $49,380** **RT Annual $41,463**	**Projected Total $185,000** **RT % of Annual Total 84%**
Annual Report Reference:	**#16, Page 233, R-69**	

PART I

OBJECTIVES:

1. To develop a small, light, inexpensive and reliable battery-operated device that will fit in the wheelchair and signal patients when they are to perform a wheelchair push-up if they have not already done so; and
2. to evaluate the long-range effectiveness of this automated training system in preventing long duration pressures in a wheelchair.

METHODOLOGY: Apparatus will be constructed consisting of a pressure switch, a timer, a sound-emitting device, and a counter. The buzzer will sound unless the patient raises off of the chair for three seconds at set time intervals. The counter will tabulate the number of push-ups. Paraplegic patients will be assigned to two groups. One group will have the buzzer warning device and the other group will not. Followup data will be obtained to determine whether training did occur by use of the warning device.

FINDINGS TO DATE: Control data was collected. Two major problems became apparent. The hospitalized patient does not spend enough time in the wheelchair to collect the data. Also, it was difficult to determine whether a weight shift was a conscious push-up or simply the result of some activity. This part of the project will be suspended until Part II of the project is completed.

APPLICABILITY: Skin breakdowns are quite common in patients who have not established patterns, before they leave the hospital, of doing push-ups independently of staff reminders. A method that would help patients to establish the habit of doing push-ups would reduce a major cause of morbidity of spinal cord injured patients.

PART II

OBJECTIVES:

1. To obtain continuous recordings for periods of 8 hours of the pressure and temperatures over the ischial tuberosities and/or posterior surface on both normal and spinal cord injured persons;
2. to correlate the pressure-time patterns of patients with no history of ischemic ulcers with patients who have developed ulcers; and
3. to estimate the frequency and duration of push-ups needed to prevent ischemic ulcers.

METHODOLOGY: Data will be recorded on a small, portable four channel tape recorder (Medilog) able to record data continuously for 24 hours. Small, thin pressure transducers will be used to record the pressures over the ischial tuberosities. A LINC digital computer will reduce the data. The capillary pressure of 32 mmHg will be carefully studied.

FINDINGS TO DATE: Not applicable at this time.

APPLICABILITY: Data on the frequency and duration of push-ups or shifts in the position that spinal cord injured patients must do to prevent the development of ischemic ulcers would greatly aid in the creation of a workable program to prevent ulcer generation. The generation of ischemic ulcers is one of the major medical problems that causes repeated hospitalization and loss of work time for spinal cord injured patients.

University of Washington (RT-3)
Medical Rehabilitation Research and Training Center

CORE AREAS

Bioengineering

Biophysics: The bioeffects of nonionizing radiation (electromagnetic, high frequency current, acoustic wave propagation, radiant and conductive heat) resulting in improved designs of therapeutic applicators in the various modalities for safer and more effective use. The basic rationale for the use of specific methods to heat specific human structures is described. National and international standards for safety and efficacy are also discussed.

Biomechanics: Detailed theoretical and actual study of lower extremity biomechanics. The quantification of force interactions between limbs and orthoses has resulted in the more precise fitting of orthotic design to patient need. Analyses of commercially-available and experimental orthoses continue to be made.

Engineering Applied to Clinical Problems: The development and evaluation of adaptive aids through human factors engineering to contribute to improved clinical service.

Behavioral Sciences

Research predominantly centered around the introduction of learning-based behavior modification strategies to traditional rehabilitation by increasing self care skills in the physically disabled and decreasing the impact of chronic pain. Work is focused on those items which might be predictors for success or failure in a contingency management program. Biofeedback represents another more specialized technological application of learning-based strategies to be examined. Additionally, different treatment methods in speech and communication will be reviewed for their effectiveness.

Neurophysiology

Elevating the knowledge of neuromuscular electrodiagnosis and discoveries of animal models for various human crippling disorders.

Muscle Physiology

Maximizing positive functions of normal or diseased muscle and minimize secondary disabilities resulting from damaged or impaired muscle.

Health Care Delivery

A series of projects related to the improvement of efficiency and quality of health care, whether through the expansion of training to meet demand or the study of the cost-benefits of rehabilitation outcomes of certain categorical diseases.

UNIVERSITY OF WASHINGTON

Justus F. Lehmann, M.D., Director
University of Washington Medical
Rehabilitation Research and Training Center
CC 814 RJ-30
Seattle, Washington 98105

PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

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Temperature Measurement in the Human Thigh During the Application of Hot Packs Followed by Ultrasound (J.F. Lehmann, M.D.) 048

A Controlled Study of the Use of Temperature Feedback for the Treatment of Raynaud's Disease (R.S. Fowler, Ph.D.) 049

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Evaluation of Wheelchair Designs for Quadriplegic and Paraplegic Patients (C.G. Warren, M.P.A.)

PROPOSED

Evaluation of Low Cervical-High Thoracic Orthoses

Development of an Objective Method for Evaluation of Viscoelastic Properties of Joints

Electromyographic Analysis of Postural Adjustment During Movement of the Upper Extremities

The Effect of Parachlorophenyl Gamma Aminobutyric Acid (Baclofen) on External Urinary Sphincter Activity in Spinal Cord Injured Patients

Interpersonal and Vocational Consequences of Head Injury

047 Quantification of the Biomechanical Function of Various Designs and Adjustments of Ankle-Foot Orthoses

Principal Investigator: Justus Lehmann, M.D.
Status: Completed
Dates: January 1969-December 1977
Cost: Annual $48,813 — Projected Total $126,902
RT Annual $40,789 — RT % of Annual Total 83%
Annual Report Reference: #16, Page 141, R-34

OBJECTIVE: To evaluate the biomechanics of various foot ankle orthoses and their safety and effect on hemiplegic gait.

METHODOLOGY: A transducer is used which measures the movements about the ankle joint and can be applied to the patient's orthoses without modification. A large number of hemiplegic patients have been sampled. Static testing is done to determine what reactive forces are provided by the various orthotic designs. The reactive forces from the force plate are used in conjunction with the location of the medio-lateral axis of rotation. The medio-lateral stability provided by the orthosis is evaluated; the knee stability is evaluated using the force vector from the floor combined with measurement of the axis of rotation of the knee joint.

FINDINGS TO DATE: Reviewing general findings (specified in the project report): the relatively unchanged ground reaction forces, the significant increase in orthosis moments, and minor change in knee stability (i.e. knee angle and moment) suggests that the orthosis adequately substitutes for the loss of muscle function at the ankle induced by the nerve blocks.

These data will be correlated with R-136 to allow comparisons of artificially paralyzed limbs with various degrees of spasticity exhibited by the hemiplegic patients. We now have data which define the restraining forces the orthosis must provide to substitute for complete loss of muscle function in the lower limb.

APPLICABILITY: Since improved ability to walk could greatly enhance the rehabilitation of hemiplegic patients, these findings will have wide utilization in the management of stroke patients as well as in management of other upper motor neuron lesions requiring foot-ankle orthosis.

048 Temperature Measurement in the Human Thigh During the Application of Hot Packs Followed by Ultrasound

Principal Investigator: Justus Lehmann, M.D.
Status: Completed
Dates: October 1973-October 1977
Cost: Annual $13,017 — Projected Total $121,756
RT Annual $6,453 — RT % of Annual Total 49%
Annual Report Reference: #16, Page 102, R-103

OBJECTIVES: To determine the effect of sequential application of hot packs and ultrasound and to determine the effect of precooling the surface of the tissue prior to ultrasound treatment.

METHODOLOGY:

1. Normal volunteers would be utilized.
2. Temperature measuring probes would be placed in the anterior-lateral aspect of the thigh with the sensing elements located at the midline of the thigh adjacent to the femur.
3. Hot packs (140-160°) were applied for 8 minutes, and ultrasound applied for twenty minutes or until the subject felt some periosteal pain. The range was from 10 to 15 minutes.

FINDINGS TO DATE: Temperature distributions were measured in the anterior thigh of five human volunteers after preheating with a hot pack followed by ultrasound. This is a treatment procedure which is used quite frequently in therapy.

It was found that preheating the skin surface with a superficial heating agent can be done without losing the selective heating of joint structures produced by ultrasound. The skin surface and subcutaneous tissue temperatures rise, but are held below deep temperature because of the continued cooling by convection, conduction, application of room temperature mineral oil and the cooling effect of the increased blood flow. Preheating the skin surface, although it does no harm, offers no advantage.

APPLICABILITY: A large proportion of the therapeutic heat treatments given are some combination of superficial heating or cooling with deep heating using ultrasound. If in fact the deep temperature can be elevated more effectively by the sequential application of superficial heating or cooling in conjunction with ultrasound, this type of treatment would become more desirable for use on patients.

049 A Controlled Study of the Use of Temperature Feedback for the Treatment of Raynaud's Disease

Principal Investigator:	**Roy S. Fowler, Jr., Ph.D.**	
Status:	**Completed**	
Dates:	**January 1975-January 1978**	
Cost:	**Annual $8,884**	**Projected Total $45,734**
	RT Annual $7,130	**RT % of Annual Total 80%**
Annual Report Reference:	**#16, Page 240, R-108**	

OBJECTIVES:

1. To test the effectiveness of feedback temperature training introducing voluntary handwarming in patients suffering from Raynaud's Disease and Raynaud's phenomenon.
2. To test the long term effectiveness of the training procedures.
3. To identify the role of the placebo in biofeedback treatment programs for Raynaud's Disease.

METHODOLOGY: Subjects diagnosed as having Raynaud's disease and Raynaud's phenomenon by medical evaluation will be referred for biofeedback treatment. Twenty subjects will be randomly divided into two groups. Group one will be the Treatment Group. They will receive eight weeks of feedback training with sessions scheduled twice a week, each session will last 30 minutes. Treatment procedures to be followed are described in detail in reference #5. Group two will be the Control Group. These subjects will receive a bogus or noncontingent feedback for eight weeks. Feedback played to subjects will be derived from the records of previously successful subjects. An average pattern will be recorded on tape and played through the feedback device to the subject.

Records will be kept of intensity of pain, frequency of discomfort and medication intake. Treatment effectiveness will be evaluated on the basis of voluntary control of finger tip temperature, decrease in pain medication records and frequency and intensity of discomfort. At the end of the eight weeks of active treatment all subjects in the control group will be offered feedback treatment. Each subject will be followed for a minimum of one year with contact occurring at four month intervals.

FINDINGS TO DATE: 22 subjects completed the study including one year followup. The feedback procedures were found to be effective in procing handwarming in all but two of the ww subjects. This was true for patients suffering from both primary and secondary Raynaud's.

Virtually all patients could produce handwarming on demand when seen at followup. The skill, once learned, does not seem to be lost with time. A significant reduction in the number of hours per day rated as having cold hands was found across time. No statistically significant changes were reported in the number of hours of pain nor in the average intensity of pain. This seems to be an artifact of the discovery that virtually none of the patients rated cold hands as painful.

The finding that the yoked control group learned as effectively as the feedback group does little to resolve the question of placebo effect in teaching handwarming in Raynaud's patients. It is apparently easier to reliably produce handwarming than was once thought. In either case, this study has produced a simple, economical and innocuous set of procedures which will have the effect of producing voluntary handwarming.

APPLICABILITY: It has been estimated that Raynaud's disease or its symptoms affect approximately 20% of most young people in its mildest form. In its most severe form, frequently connected with other identifiable pathological processes, amputation of fingers and toes is observed. Medical treatment has been defined at best as "providing only partial relief." Surgical procedures such as sympathectomies and potential dangerous vasal dialating drugs are not uniformly successful and the side effects are potentially dangerous. Biofeedback treatment procedures hold considerable promise as a safe patient controlled treatment program for this sometimes severely disabling disease. It is anticipated that biofeedback will become the treatment of choice for the early management of Raynaud's symptoms. It will be chosen as an alternative to medication and/or surgical procedures.

050 The Effectiveness of EMG Muscle Relaxation Training as a Function of Feedback Mode and the Muscle Trained

Principal Investigator: **Roy S. Fowler, Ph.D.**
Status: **Completed**
Dates: **January 1976-January 1978**
Cost: **Annual $13,943** **Projected Total $29,500**
RT Annual $11,902 **RT % of Annual Total 85%**
Annual Report Reference: **#16, Page 249, R-109**

OBJECTIVES:

1. Develop standardized replicable EMG based feedback procedures for muscle relaxation training.
2. Test the differential effectiveness of these treatment procedures.
3. Test the relationship between type of muscle trained and the feedback procedure used.
4. Test the effect of a technician's presence in influencing treatment.
5. Develop treatment equipment which will reduce manpower needs and treatment costs.

METHODOLOGY: Three muscles will be targeted for relaxation training. These include the frontalis, which has been said to be most important in the treatment of tension headache; the trapezii, often involved in shoulder/back problems and the cervical para-spinals which are thought to play a role in both tension headache and neck and shoulder problems.

Four EMG feedback procedures will be employed. These include: A) analog feedback in which feedback is provided by a meter which indicates tiny changes in muscle tension or relaxation; B) shaping, in which subjects will first receive a baseline score. This score will represent the microvoltage output for three consecutive 10 second trials without feedback. The average of these trials will be calculated and this score used as a starting point for training. Subjects will be asked to achieve this score. If they do so they will turn on a green light and trip a counter which will record the percentage of each 10 second trial during which the green light is on or the subject has relaxed below his initial baseline level. An 85% success criterion will be used. Adjustments will be made to the trip point selection following each successful trial so as to demand greater and greater relaxation per trial. C) automated feedback shaping procedures in which feedback to the subject will be essentially identical to that received in mode B except the process will be totally automated. All instructions will be provided through a digital readout from a TV monitor. The subject will control his own pace. Recording of results will be automatic. Another person will be involved only to place and remove electrodes; D) Control in which noncontingent or "bogus" feedback will be provided in the form of a visual analog. The feedback will be provided by a tape recording of EMG signals from successful subjects. This tape recording will be played through the meter in such a way as to suggest to the subject that he is obtaining feedback from his own muscles.

FINDINGS TO DATE:

1. Procedures developed for the study were consistent, reliable and effective in producing reductions of muscle activity except the automated procedure when used to train the masseter.
2. No statistically significant differences were found between treatments in terms of effectiveness.
3. The trapezii produced higher resting baselines of muscle activity than the masseter or frontalis, but were equally easy to train.
4. Treatment with a technician present produced the greatest reduction in muscle activity but the differences were not significant. It would appear that the technician's presence during treatment is not critical to the significant reduction of muscle activity when effective feedback is provided.

5. The automated feedback procedure and the feedback alone procedure (A and C) do not demand the presence of a therapist or technician during treatment. This suggests that treatment can be made more economical than has come to be traditional in conventional feedback treatment programs in which a therapist is usually present throughout treatment.

APPLICABILITY: This study will provide information which will allow for the development of more effective disability reducing treatment procedures. It should also increase the success rates of biofeedback treatment programs, increase replicability of results across institutions utilizing such procedures, increase the general effectiveness of biofeedback treatment programs, and significantly reduce the need for the use of potentially dangerous drugs and/or destructive surgical procedures.

051 Effective Training in Rehabilitation Medicine in New Medical School Curricula

Principal Investigator:	**Frederick Kottke, M.D.**	
Status:	**Completed**	
Dates:	**October 1974-January 1978**	
Cost:	**Annual $920** **RT Annual $920**	**Projected Total $111,079** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 453, R-116**	

OBJECTIVES:

1. To determine the extent to which exposure to rehabilitation medicine education experiences helps to develop in all medical students an understanding of the nature of chronic illness and its complications, and a working knowledge of the contribution which rehabilitation medicine offers to meet the multiple needs of the chronically ill. Specifically, the project will attempt to determine whether this exposure stimulates positive attitudes toward rehabilitation medicine, a working knowledge of rehabilitation medicine principles, and effective practice behavior in providing care for the chronically ill and severely physically disabled.
2. To identify newer types of prototypic rehabilitation medicine educational experiences which are effective and which are likely candidates for inclusion in today's medical school curricula.

METHODOLOGY: Through mail surveys of practicing physicians who have been exposed to (or, in the case of comparison subjects, who lacked exposure to) different types of PM&R education experiences at these schools, it will be possible to determine to at least some meaningful degree the important and long lasting attitudinal and behavioral effects stimulated by varying types and degrees of exposure to medical school PM&R educational experiences.

In essence, by using a retrospective research design which takes advantage of natural experimental situations and events which have occurred in four medical schools, these situations and events will make these schools and their curricula meaningful and representative targets for study.

FINDINGS TO DATE: In 1976-77, the mail survey was completed and the result analyzed. In 1977-78, the final draft of the report was drawn up and circulated. It is of particular importance that of those involved in direct patient care, 84% provide services to the chronically ill and severely disabled. Of the latter 61% are in primary care specialties. Thus the importance of exposing medical students to rehabilitation medicine is confirmed.

To conclude and summarize findings, it appears that the degree of exposure to rehabilitation medicine during medical school is positively associated with later effective practic behaviors in dealing with chronically ill and severely disabled individuals. Additional analyses will attempt to identify correlates of positive attitudes toward rehabilitation as well as relate attitudes with physician practice behavior.

The final report will be submitted to the **Archives of Physical Medicine and Rehabilitation.** It will also be published as a Commission on Rehabilitation Medicine Bulletin to be distributed to deans of medical schools, chairmen of physical medicine and rehabilitation departments and other program directors.

APPLICABILITY: This study has been designed to aid medical school policy makers by answering meaningful questions about relevant types and combinations of rehabilitation medicine experiences which they might realistically consider for inclusion in medical school curricula. The installation of more effective RM educational experiences could eventually lead to a greater proportion of the nation's severely disabled and chronically ill receiving more effective rehabilitation services.

052 Incorporation of a Lexan "Check Socket" into a Definitive Patellar Tendon Bearing Prosthesis

Principal Investigator:	**C.G. Warren, M.P.A.**	
Status:	**Completed**	
Dates:	**October 1975-October 1977**	
Cost:	**Annual $12,237** **RT Annual $10,034**	**Projected Total $10,034** **RT % of Annual Total 82%**
Annual Report Reference:	**#16, Page 178, R-122**	

OBJECTIVES: The objectives of this study are to establish a method of incorporating a lexan check socket into a structural mechanism which is lightweight, adjustable, and upon which the subject can ambulate for periods of time significant enough to evaluate the fitting of the socket, anywhere from 3 days to 3 weeks. In the long range, it is possible that if the lexan proves to be suitable as a long term definitive socket material that this methodology could be expanded to incorporate the lexan socket into the definitive prosthesis.

METHODOLOGY: The method of mounting the lexan socket utilizes an inverted fiberglass cone or funnel into which the lexan socket is placed and mechanically interlocked by the strapping method. It can be further stabilized, if necessary, by foam support in the lexan socket within the cones. The cone is attached to a wooden block which carries the conventional bolting assembly to the alignment devices, pylon and foot. The socket can be retrieved from the fiberglass cone by unstrapping it.

The structural integrity of the unit was tested under simulated walking conditions.

FINDINGS TO DATE: With the results of this evaluation it is evident that the prosthesis can sustain the static loads and it is safe for limited ambulation by the patient. We have not as yet formally established the fatigue characteristics of the coupling (i.e. how it will perform under dynamic loading). However, further evaluation of the data obtained in the static test analysis will allow us to determine the importance of conducting cyclic loading at load rates incurred in normal ambulation. The static data will allow some prediction of the likelihood of breakdown under dynamic stress.

APPLICABILITY: The prosthetists who use this Lexan check socket at the present time cannot have the patient walk on the socket and must add several additional visits to their schedule during the primary fitting. For these reasons many do not use the technique.

If this socket could be incorporated into a prosthesis for a period sufficient for evaluation, many more prosthetic facilities would begin to use the Lexan sockets. Their use could reduce the frequency of ill-fitting prostheses and complications due to skin trauma produced by ill-fitting prosthesis.

In addition, the total cost of producing a prosthesis may be reduced and subsequent and repeated alterations may be reduced or eliminated.

053 Rehabilitation Needs of Cancer Patients

Principal Investigator:	**Justus Lehmann, M.D.**	
Status:	**Completed**	
Dates:	**September 1976-September 1977**	
Cost:	**Annual $** **RT Annual $**	**Projected Total $104,591** **RT % of Annual Total**
Annual Report Reference:	**#16, Page 465, R-129**	

OBJECTIVES: The objectives of this study are to screen the cancer population in order to determine type and frequency of rehabilitation problems occurring in this population and thus to produce a quantitative estimate of the need for various rehabilitation services. Special effort will be made to identify gaps between a recommended rehabilitation program and that actually received. When such gaps in the health care delivery system are identified, an effort will be made to identify the barriers or obstacles which prevent the patient from receiving the optimal rehabilitation care. Identification of barriers would lead to recommendation of remedial action and finally a test of the effectiveness of the recommended approach toward ultimate resolution of the problem.

METHODOLOGY: **Development of a model system for rehabilitation care delivery.** Based on the initial analysis of the sample, a rehabilitation care delivery model was established.

The consultation process provided an additional means of introducing rehabilitation concepts to the oncologist. This contact over the problems of an individual patient can be considered an educational tool. It not only conveys information but may also change future behavior.

In order to asses the effectiveness of both the formal educational program and of the automatic consultation component of the model, another comparable sample of the patients in the 11 most frequent cancer sites were screened using the same methodology as the first screen. A recommended program of optimal rehabilitation care was again developed and compared with the rehabilitation care the patient actually received in order to identify the gaps. The results after the establishment of the education program and after the establishment of the total model, including the consultation component, were compared with the results obtained in the initial sample. It is obvious that the percentage of patients who did not receive any recommended care at all has been markedly reduced by the educational program and indeed more so by the implementation of the triage and consultation process. The percentage of patients who had received only part of the recommended program was also reduced after the total model was implemented. Thus the implementation of the model conspicuously closed the gap in the delivery of rehabilitation care.

The total difference between the identified gaps in the first screen as compared with the screen after the establishment of the educational program and after the implementation of the total model is significant at the $p < 0.001$ level. The difference between the gaps identified after the establishment of the educational portion and after the implementation of the consultation program of the model was significant at the same level. The level of statistical significance for physical therapy, occupational therapy, psychology and rehabilitation medicine services in comparing the first screen and that after the educational program and the first screen and after implementation of the total model was $p < 0.01$. Speech pathology, rehabilitation nursing, social service, and vocational counseling show no statistically significant changes because of the small "n" for each of these services.

The number and types of barriers to rehabilitation care were also compared. Barriers were defined as that which prevented the patient from getting the full recommended rehabilitation program. The percent of people in the sample who experienced barriers to rehabilitation care was noticeably reduced both by the education program and further by the implementation of the total program with consultation services. The differences between the barriers assessed in the first screen and after part and full implementation of the model are all significant at the $p < 0.001$ level. The distribution of these barriers was greatly altered once the program was totally implemented. The few remaining barriers were evenly distributed; and the main barrier during the first screen - lack of identification of patient problems - was virtually eliminated. Lack of referral to rehabilitation was reduced from 21% to 2% which shows a high degree of acceptance of the recommendations through the consultation process.

In order to assure that the initial screen did not influence the behavior of the therapeutic team toward the cancer patient with rehabilitation problems and in order to further verify the effectiveness of the model, the referrals to rehabilitation services were assessed prior to and after the initial survey and again after the implementation of the model. For this purpose only part of the population was sampled. The number of patients seen per month was not significantly increased from the period prior to the first screen to the period right after the first screen and before the establishment of the service delivery model. Neither was the volume of care increased as counted by visits to the various services. However, both numbers were more than doubled after the care model was established and implemented.

FINDINGS TO DATE: Since the cancer population in this study was similar although not identical to a national sample, only general conclusions, qualitative in nature, can be drawn from the findings. These conclusions may be applicable elsewhere as well. According to the study, psychological and physical rehabilitation problems are common in patients with cancers at most sites. Many of these problems were judged amenable to therapeutic intervention since the problems most frequently encountered were similar to those from disabilities of other origin.

Thus the survey in this study confirms the need of these cancer patients for rehabilitation care. It also identified major gaps in rehabilitation care delivery to cancer patients. The barriers which blocked optimal rehabilitation care were identified. On this basis, a model rehabilitation care delivery system was established and its effectiveness in removing barriers tested. It was concluded that the frequency of psychologic problems in cancer patients without physical disabilities suggests that adequate psycho-social support as might be provided by a trained social worker under the supervision of a psychiatrist or psychologist should be available on any oncology service. Since the psychologic problems in cancer patients with physical disabilities were often more severe and associated with a need for physical medicine treatment approaches, a comprehensive, well-coordinated rehabilitation team is required for their care in many instances. For the severely involved, this treatment setting should include the availability of 24-hour psychologic support for behavior management programs.

From the documented effectiveness of the model, one may conclude that cancer care is improved by the establishment of an oncology team; if a physiatrist is an integral part of that oncology team, the gaps in rehabilitation care delivery may be removed. The physiatrist in his capacity as a team member links a comprehensive rehabilitation team to the oncology services. In order to improve individual patient care in the area of rehabilitation, a rehabilitation care coordinator should be available for the screening and triage of the cancer population served by the oncology team. After examination of those patients with potential rehabilitation problems by the physiatrist, advice on rehabilitation care may be delivered via consultation. This advice, if accepted, is implemented as appropriate. From testing the effectiveness of this system, it can also be concluded that an educational program is desirable if not necessary.

The total model system can rapidly remove barriers to and gaps in the delivery of rehabilitation care. Even though the main components of the described model are important, they may be modified and adapted to suit the differences in individuals' settings.

APPLICABILITY: The findings will be primarily utilized to alter the health care delivery system so that the appropriate services are available for the appropriate cancer sites and the results will be used as a quantitative basis for planning of such a model delivery system.

054 Quantification of Speech Intelligibility of Dysarthric Speakers: Development of a Multiple Choice Technique

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1977-March 1978**	
Cost:	**Annual $6,268** **RT Annual $4,313**	**Projected Total $13,500** **RT % of Annual Total 68%**
Annual Report Reference:	**#16, Page 293, R-141**	

OBJECTIVES:

1. to develop a system for quantifying single-word intelligibility which is sensitive to progress of severely dysarthric speakers and which eliminates the need for naive judges in objective measures of dysarthric intelligibility;
2. to compare data from multiple choice judgments and Tykofsky-type, word-identification judgements;
3. to compare equivalency of stimulus lists which are selected randomly.

METHODOLOGY: Fifty sets of twelve words were constructed. Each set contained four words taken from lists constructed by Black and Hagen (1963) plus eight similar sounding words added by these investigators. A series of 50 word samples was created by randomly selecting one of the 12 words for each of the 50 master sets. Nine dysarthric individuals served as speakers. A different 50 word sample was selected at random for each speaker. Audio recordings were made of each speaker reading his 50 word list. Five speech pathologists with experience in dysarthria treatment but initially no familiarity with the word lists served as judges. They listened to each speaker's 50 word sample under the following conditions: judges heard each word and wrote it down; judges heard each word and then chose the word from a list of four alternatives; judges heard each word and then chose the word from a list of eight alternatives; judges heard each word and then chose the word from a list of twelve alternatives; judges repeated the pre-condition test of hearing and writing down. Under conditions I, II, and III judges not only selected the word spoken but also had the opportunity to indicate if their response was a guess. Percent agreement was computed by dividing the number of first and second responses that were the same, i.e. +/+ or -/-, by the total number of possible responses; and Pearson product-moment correlations for test-retest reliability were calculated by comparing correct response made by each judge to five items produced by each speaker.

FINDINGS TO DATE: The findings were: 1. a multiple choice system for quantifying the intelligibility of dysarthric speech was developed. This tool consisted of 50 items with 12 choices in each item category. 2. All five methods of quantifying speech intelligibility ranked the dysarthric speakers similarly. 3. There was a method hierarchy in which some methods consistently produced higher intelligibility scores than others. The multiple choice methods are more sensitive to speakers who are moderately to severely unintelligible. 4. Correlations between the scores derived from two randomly drawn stimulus lists for each of twelve speakers was .93 for the multiple choice methods and .91 for the transcription method.

APPLICABILITY: Since dysarthria, a sequel of brain injury, frequently occurs concomitant with other physical disabilities, persons with dysarthric speech are frequently served in rehabilitation centers. Decision making regarding acceptance into treatment, dismissal from treatment, efficacy of specific treatment techniques and modification in medication needs to be based on data which is as objective and reliable as can be gathered. The research described in this project was designed to develop an objective tool which is sensitive to behavior change in the speech of persons with severe and moderate dysarthria in a manner which will reduce the data contamination resulting from familiarity with the stimulus material. This information will not only enhance decision making, but will provide data to severe dysarthric speakers so that they may be more accurately aware of the changes in their speech performance.

055 Quantification of the Speech Intelligibility of Dysarthric Speakers: A Comparison of Several Procedures

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**Completed**	
Dates:	**June 1977-June 1978**	
Cost:	**Annual $5,865** **RT Annual $5,865**	**Projected Total $12,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 301, R-142**	

OBJECTIVES: To prepare "new" procedures for objectively quantifying single word and sentence intelligibility of dysarthric speakers; to compare the sensitivity and reliability of objective methods and estimate (rating scales) methods for quantifying overall dysarthric speech, and to compare the performance of naive listeners and practicing speech pathologists as they judge the speech samples under the various scoring systems.

METHODOLOGY: All of the stimulus materials associated with the tasks were recorded from eight dysarthric speakers with a range of severity from clearly unintelligible to intelligible. The dysarthric speakers represented various types of dysarthria, as this project attempted to explore clinical techniques which are used over a wide range of patients.

There were two types of listeners. Naive listeners (non-speech pathologists unfamiliar with the stimulus material) listened to selected items under each experimental task for each speaker. The listeners were grouped in such a way that they did not hear the same stimulus material twice, so that their results could not be confounded as they became familiar with the stimulus material. Four judges were included in each group; thus the total number was 32.

A second set of listeners were professional speech pathologists who were familiar with dysarthric speakers. These professional listeners were exposed to all items of all dysarthric speakers under all conditions. Since speech pathologists who work in a clinical setting become familiar with the stimulus materials, the comparison of their performance with the performance of naive judges took into account the familiarity issue. Fifteen percent of speech samples collected under each quantification procedure were selected at random and judged a second time for reliability purposes.

The intelligibility scores under each of seven quantification procedures were compared to determine the relative sensitivity of each of these methods for quantifying intelligibility. Intra/Inter Judge reliability was determined so that the relative reliability of each of the several quantification procedures could be compared.

FINDINGS TO DATE: Eight techniques for quantifying intelligibility of dysarthric speech were compared. Eight dysarthric speakers who represented a wide range of severity were recorded producing single words and sentences. Thirty-two college students performed the following intelligibility quantification tasks: percentage estimates, rating scale estimates, word and sentence transcriptions, word and sentence completions, and word and sentence multiple choice tasks. Intelligibility scores for transcriptions were compared to estimates and to other objective tasks with the following results: 1. all measurement techniques, except word completion, rank-ordered speakers similarly to transcriptions; 2. mean estimates of intelligibility closely parallel transcription scores, but dispersion of listener estimates was large; and 3. objective tasks from a hierarchy with speakers receiving lowest scores on transcriptions, intermediate scores on completions and and highest scores on multiple choice tasks. Mean scores forwords and sentences were similar.

APPLICABILITY: The physical, intellectual, social and vocational residuals of brain injury often require rehabilitation. Many brain injured patients exhibit communication problems, and some of these persons are dysarthric speakers. Development of more complete systems to quantify overall speech performance will permit the refinement of diagnostic techniques which will permit increasingly reliable and sensitive measurement 1. of changes in speech performance, and 2. to determine the effect of speech treatment and prosthetic management, and 3. to judge more effectively the influence of chemical management on dysarthric speakers.

056 Postoperative Care of Patients with Total Hip Joint Replacement Using Ultrasound

Principal Investigator:	**Justus Lehmann, M.D.**	
Status:	**Continuing**	
Dates:	**August 1971-July 1978**	
Cost:	**Annual $9,506** **RT Annual $7,896**	**Projected Total $88,788** **RT % of Annual Total 83%**
Annual Report Reference:	**#16, Page 56, R-2**	

OBJECTIVE: To assess whether ultrasound can be used safely in an area which has a prosthetic joint incorporating methyl methacrylate and high density polyethylene.

METHODOLOGY: An ultrasonic transmission line will be used to measure the acoustic properties of methyl methacrylate and the high density polyethylene. The longitudinal and shear velocities as well as the loss in the longitudinal shear modes will be calculated. The sample of methyl methacrylate will be prepared according to the directions supplied for preparing the materials for surgical use. Pieces of material will be machined to allow placement in the transmission line. Measurement of density will be made using the standard displacement technique and specific heat will be measured with a calorimetric method. The measurement of thermoconductivity will be made in a thermodynamic laboratory.

FINDINGS TO DATE: Because the described method for preparing methyl methacrylate causes rather gross nonuniformities in the individual samples, there was a wide variation in the shear and longitudinal velocity measurements. This was also true of the measurements of longitudinal and shear attenuation. These factors indicate that there is likely a large range in the estimated heating effects produced by ultrasound where methyl methacrylate is implanted.

The attenuation measured in the sample is not due solely to the absorption, but is rather caused by the combination of absorption within the sample and scattering due to inhomogeneities.

APPLICABILITY: Ultrasound application could be a valuable adjunct in the postoperative care of the total hip procedure. Vigorous application of ultrasound to heat the structure around the hip would increase rate of healing and possibly reduce pain, making the patient a functional ambulator in less time, if this technique is safe.

057 Program on the Quantitation of the Effects of Electromagnetic Energy on Human Tissues

Principal Investigator:	**Arthur W. Guy, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1970-June 1980**	
Cost:	**Annual $517,425** **RT Annual $49,020**	**Projected Total $2,200,000** **RT % of Annual Total 9%**
Annual Report Reference:	**#16, Page 61, R-5**	

OBJECTIVE: To advance the existing knowledge on the quantitative effects of electromagnetic radiation on the human body and to provide realistic guidelines for safety standards of human exposure.

METHODOLOGY:

1. Establish quantitatively the electromagnetic field patterns both in and exterior to the tissues of human subjects and test animals due to external sources of energy.
2. Expose the test animals to the various CW and modulated electromagnetic sources at both thermal and nonthermal lower levels while monitoring the energy of the tissues.
3. Observe the physiological and behavioral characteristics of the animals before, during, and after exposure to electromagnetic radiation.
4. Determine the time and power density thresholds for cataract production in animals exposed to microwave radiation.
5. Determine what levels of fields mankind can be safely exposed to, taking into proper account the source, configuration, frequency, and location.
6. The theoretical analysis involves solution of Maxwell's equation for the absorbed power by biological systems for a host of different geometries.
7. The experimental studies involve controlled exposure of test animals to selected sources of electromagnetic energy with the aim of quantifying observable effects and changes on the biological systems.

FINDINGS TO DATE: In addition to the experimental development of quantitative methods for assessing the biological effects of microwave fields involving thermograms and phantom materials, theoretical studies were carried out for a better understanding of the relationships between exposure frequency and the dielectric properties, size, and shape of exposed objects. Several neurophysiologic experiments were carried out with special emphasis on delineating the mechanisms of the microwave effects obtained. The levels at which biological effects were observed were always determined in terms of actual energy absorption in the exposed tissue. The work on improvement of dosimetric and exposure techniques has provided a means for other researchers in pursuing the studies of biological effects of low level, chronic exposure to microwaves.

For therapeutic purposes we have also developed safe methods and evaluated hazards for the application and monitoring of electromagnetic energy in diathermy practices.

In studies of neurophysiological and behavioral effects, we have found the microwave dose-response relationship to be highly dependent on the ambient temperature at which the studies are conducted. Indirectly, this implicates our earlier chronic exposure findings as thermoregulatory disturbances and/or accommodations, rather than some unique nonthermal consequence of microwave exposure.

Finally we have concluded our microwave hearing research with two studies, one demonstrating that the threshold for microwave hearing (defined as brain stem evoked response) is a function of the density of absorbed energy at pulse widths less than 30 sec. and a function of peak power density once pulse widths exceed 70 sec. The second study demonstrated further the absolute necessity for cochlear stimulation to obtain microwave hearing, implicating conduction of pressure waves through the bones of the skull as the mechanism responsible.

In studies of microwave radiation effects on the head and eyes of rabbits, the presence of a specific, non-thermal microwave factor was found unlikely in microwave cataractogensis.

Attempts to replicate Soviet research on chronic exposure of rats to 500 mW/cm^2 2450 MHz, CW microwaves in individual anechoic chambers agreed in part with their findings, and clearly suggest a need for further low-level microwave exposure protocols.

Research and development has been completed on new cell culture exposure systems suitable for operation at frequencies up to 1 GHz. A number of primate lymphocyte cell cultures, cancer cells and other cell preparations have been exposed. To date, no effects have been seen that can be attributed to the radiofrequency fields. This information is significant and provides valuable information concerning possible deleterious or beneficial effects of 27 MHz shortwave diathermy.

Experiments on the biological consequences of pulsed versus continuous wave radiation show no effects on the blood brain barrier in mice or heart rate in rabbits. The dose for producing the microwave stun effect corresponds to a specific absorped energy density of 25-30 Joules per kg deposited in the brain of exposed rats.

Solid scale models of Hanford swine and man have been fabricated as master forms and filled with synthetic muscle tissue and exposed in a VHF cavity. As a result of the exposure, the induced currents heat the synthetic tissues and thermograms can be made of the specific absorption rate of the radiofrequency energy. This information has been extrapolated down in frequency to predict the current distributions in full-scale subjects exposed to ultrahigh voltage transmission lines.

APPLICABILITY: Applicable to improved clinical techniques such as diathermy and certain newly possible uses in medicine of microwave. The use of microwave energy in industrial, scientific and medical applications have increased the population at risk to unknown side effects. The close contact of our laboratory with federal authorities and the international collaboration of scientists will make the setting of standards possible.

058 Severe Physical Disabilities of Unknown Etiology: A Study of Antigens Producing Paralytic Disease

Principal Investigator:	**George H. Kraft, M.D.**	
Status:	**Continuing**	
Dates:	**January 1971-December 1979**	
Cost:	**Annual $8,510** **RT Annual $5,175**	**Projected Total $28,635** **RT % of Annual Total 61%**
Annual Report Reference:	**#16, Page 346, R-18**	

OBJECTIVES: To increase understanding of the cellular hypersensitivity mechanism and its role in disabling diseases by

(a) producing EAN in guinea pigs without (or with a minimum amount of) damage to the central nervous system.

(b) transferring this disease to recipient animals using lymph node lymphocytes.

METHODOLOGY:

1. Techniques have been developed for extracting peripheral nerve antigen and studying the time factor between injections of antigen and development of electrophysiologic abnormalities in peripheral nerves.
2. Cellular hypersensitivity involves extraction of synovial antigen which produces synovitis (arthritis).
3. Experimental diseases will be produced and studied in animals.

FINDINGS TO DATE:

A major part of this study was to determine why animals with induced EAN also develop EAE. The study we proposed in order to investigate this was one of several possible methods for studying this question. However, during this past year Abramsky, Titlebaum and Aron reported the results of a somewhat different study which addressed the same issue. Their study showed that in the peripheral nerve there are two antigens - one reacts with the peripheral nerve and the other with the central nervous system- whereas in the central nervous system there is only one antigen, which reacts with the CNS only. Therefore we need not carry out this part of our proposal.

The technique of passive transfer is a very difficult one and no laboratory has developed a consistently satisfactory technique. As noted, we were unsuccessful in attempting to transfer EAN from several donor rats to recipient rats of the same inbred strain using suspension of donor lymph node cells. During this past year we have continued to investigate these techniques since they are important to the study of delayed hypersensitivity reactions.

APPLICABILITY: Current preliminary studies of passive transfer of immune disorders have been expedited by the data made available from detailed investigation of Experimental Allergic Neuritis (EAN) in guinea pigs. Specific problems such as dosage, routes of injection and location of high lymphocyte (immune cell) concentration in diseased subjects have been examined. Moreover, information obtained from these studies has led to the credibility of EAN as a laboratory model for Guillain-Barre or Idiopathic Polyneuritis, a human disease of peripheral nerves leading, usually, to acute temporary impairment of motor function.

059 Severe Disabling Polyneuritis of Unknown Cause: The Development of a Research and Treatment Model

Principal Investigator:	**George H. Kraft, M.D.**	
Status:	**Continuing**	
Dates:	**January 1972-December 1979**	
Cost:	**Annual $9,143** **RT Annual $6,555**	**Projected Total $31,280** **RT % of Annual Total 72%**
Annual Report Reference:	**#16, Page 353, R-19**	

OBJECTIVES: To explore the relationship between experimental allergic neuritis and Guillain-Barre polyneuritis and to investigate means of therapeutic management and prevention of the disease.

METHODOLOGY:

1. Experimental allergic neuritis is induced in guinea pigs by a single intradermal injection into front footpads of an emulsion of peripheral nerve antigen in combination with killed mycobacteria in oil, an adjuvant which enhances the immune response.
2. The ensuing disease process, with clinical manifestations emerging on about day 14, is monitored in a variety of ways. Clinical observations, including the recording of weight and temperature (at the inside surface of the ankle) along with more subjective assessments of weakness and paralysis are made biweekly and with daily recording during the acute phase. Electrophysiologic examinations for indications of nerve function are performed twice weekly as well.

3. Further information is made available through the sacrifice of selected animals for routine and specialized histologic studies.

FINDINGS TO DATE: In experiments in the past year we showed that two electrodiagnostic techniques, repetitive stimulation and examination of late responses, which we had not previously used in evaluating EAN could be used in monitoring the course of the disease. There have been no previous reports of late responses in EAN and we discovered what we feel represents an R wave in the tail nerve of the rat.

These techniques as well as our previously reported measurements of nerve conduction velocity will help to evaluate changes in the pathophysiology of EAN under various disease treatments. The late response of F wave reveals changes in more proximal portions of the peripheral nerve than can be measured by standard nerve conduction velocity techniques. This will be very important in the assessment of animals with EAN since the pathologic changes in both EAN and Guillain Barre syndrome are thought to begin in the nerve roots, a region too far proximal for standard nerve conduction velocity techniques to detect. We now have a way to monitor these very early changes.

APPLICABILITY: As a result of this and other studies, Experimental Allergic Neuritis has gained a high degree of credibility as a close and genuine model for the human Gjillain-Barre syndrome. Information derived from this study, accessible to a large number of physicians and specialists in rehabilitation through presentations and publications, will be of use in treating the human disorder.

060 Mechanism and Treatment of Muscle Contracture in Disabling Diseases

Principal Investigator:	**Walter C. Stolov, M.D.**
Status:	**Continuing**
Dates:	**September 1971-September 1980**
Financial Data:	**Not reported in Progress Report #16. Activity during 1977 was in part curtailed for a period of 6 months due to insufficient funds to maintain salary of research technologist. This continued well into 1978, and the last two months in which the technologist was hired, there has only been sufficient time to introduce this person to the problem. Thus an additional year has been added to the study.**
Annual Report Reference:	**#16, Page 410, R-24**

OBJECTIVES: To simultaneously determine total muscle length, individual fiber length, number of sarcomeres, and length of tendon aponeurosis of insertion and origin in rat gastrocnemius and soleus muscle in which clinical contracture of normal and denervated muscle is produced.

METHODOLOGY: Fifteen adult rats will be weightmatched and divided into 3 groups of 5. One group will be sacrificed immediately to represent initial condition, one will be immobilized via Plaster of Paris cast and the third group will be sacrificed at 5 weeks. The calcaneous of all the muscles will be separated from the feet, the gastrocnemius muscle will be separated from the soleus and the soleus muscles will be loaded with fifteen grams of passive tension. When the weights are loaded on the anesthetized animal the length of the muscle will be fixed by a perfusion of the animal with gluteraldehyde through the aorta. The soleus muscle will be dissected out and frozen on microtome stages and sectioned.

FINDINGS TO DATE:

A. Immobilization contracture as far as the whole belly length was concerned was an arrest of growth.

B. Arrest of growth also occurred in the insertion aponeuroses plus an absolute reduction in insertion aponeurosis length.

C. Anterior muscle fiber, posterior muscle and a sarcomere number were all arrests of growth when contracture was produced.

D. Growth rates for belly length, origin and insertion aponeuroses and length of muscle fiber and sarcomere number were more directly related to body weight and were the same for all structures.

E. Immobilization contracture, therefore, was largely growth arrest plus an absolute reduction in insertion aponeuroses length with some increase in poterior muscle fiber length and hence an architectural rearrangement.

APPLICABILITY: Muscle contracture secondary to positioning is best reversed by chronic positioning of the muscle in the elongated posture. Tendon lengthening procedures should be very carefully considered in the face of muscle contracture. In all growing patients with conditions productive of contracture, meticulous periodic posturing of the offending muscles in the elongated posture should inhibit the development of contracture and subsequent loss of functional ability.

061 Motor Point Blocks Phase III

Principal Investigator:	**Barbara J. deLateur, M.D.**	
Status:	**Continuing**	
Dates:	**July 1973-June 1978**	
Cost:	**Annual $2,990** **RT Annual $2,990**	**Projected Total $23,375** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 419, R-92**	

OBJECTIVES:

1. To determine appropriate voltages for precise localization of motor nerves;
2. To correlate lesion size with magnitude and duration of temperature;
3. To determine and improve the accuracy of localization of the lesion for studying, histologically, the character, evolution, and duration of the lesion.

METHODOLOGY: The motor end plates and small intramuscular nerves will be localized in guinea pigs. An electrosurgical system suitably interfaced with probing needles will be utilized to deliver a low output current to the motor points and small intramuscular nerves.

The animal is sacrificed after two days to get good necrosis and inflammation. The gastrocnemius muscles are excised and placed in formalin. The Holmes Nerve Fiber stain is used to determine what the site and size of the damage is and whether the nerve itself has been affected. A functional test of damage to the live animal will not be done at this time since these are acute lesions and any damage seen might be due to soreness.

The lesion should be of the nerve, leading to wallerian degeneration, and to atrophy (not necrosis) of the muscle.

FINDINGS TO DATE: From histology on the first two guinea pigs, it was concluded that 45ºC and 60 seconds would be sufficient temperature and duration of current to make a satisfactory lesion.

In the subsequent 8 animals, one lesion was made in each gastrocnemius muscle at points which were most responsive to stimulation. The animals were sacrificed and the muscles excised, after at least two days, and serial sections were done to determine the true extent of the lesion and the proximity of the lesion to peripheral nerves.

The lesions were from 3 to 4 muscle fibers in thickness. It can therefore be concluded that the lesion of controllable size was produced. In spite of careful attempts at localization, no damageed nerve fibers were seen in the vicinity of the lesion.

Since this study has demonstrated that the methods used will produce a lesion of controllable size, it is proposed to use the radiofrequency lesion generator to control spasticity in human subjects who have stable lesions.

APPLICABILITY: If the option of a permanent motor point block becomes available to handicapped patients, it will mean that they can have relief without interrupting their work or activities every 4 to 6 months to return for repeat blocks. This is of particular relevance to those who live a great distance from a center where blocks are performed.

062 Gastrocnemius Muscle and Tendon Length in Normal and Stroke Patients

Principal Investigator:	**Eugen M. Halar, M.D.**	
Status:	**Continuing**	
Dates:	**December 1974-December 1978**	
Cost:	**Annual $10,457** **RT Annual $9,020**	**Projected Total $27,264** **RT % of Annual Total 86%**
Annual Report Reference:	**#16, Page 427, R-104**	

OBJECTIVES: To develop a reliable technique that could accurately measure muscle belly and tendon length changes during different active or passive ankle ranges of motion.

To determine whether loss of passive dorsiflexion in a stroke syndrome is due to a shortening of the muscle belly, or of the tendon, or both.

METHODOLOGY:

1. Human gastrocnemius muscle belly and tendon lengths will be determined through the use of ultrasound echography at several points on the leg.
2. Both normal subjects and stroke patients of varying age groups will be measured when their legs are both passively dorsiflexed and relaxed. This will establish a tension length diagram.
3. Elasticity as a function of age will be measured through the determination of muscle belly and tendon lengths at several passive tensions.
4. Ten consecutive measurements of a single limb under a single passive tension will determine how many scans should be made for any single subsequent measurement. A normal young adult group (ages 20-30) and a normal older group (ages 55-65) will be compared for right-left leg variations and age variations and will be matched according to lower limb length.
5. Fifteen to 20 patients having suffered unilateral stroke syndrome will receive prolonged passive stretching and measurement of their right and left leg with the opposite serving as control, for 20 minutes, twice a day and lasting a period of 3-4 months. These patients will be compared to each other and the normal group.
6. It was decided to test 60 subjects, 30 normals and 30 stroke patients for the part of the study regarding shortening and elongating properties of the gastrocnemius muscle. An additional 30 stroke patients will be tested for the treatment of the gastrocnemius muscle contracture.

FINDINGS TO DATE: In normal and hemiplegic subjects, only the gastrocnemius muscle belly elongates or shortens during ankle ROM. There was no statistical difference in elongation characteristics of the muscle bellies between hemiplegic and nonaffected legs of the same patients, or between spastic and flaccid gastrocnemius muscle. The above findings, in comparison with the finding of a clinical contracture indicate that the patients actually had a functional rather than structural contracture. These findings also indicate that the spasticity is the cause of the reduction of muscle resting length, but is not the cause of an intrinsic muscle contracture, at least not in early stroke syndrome patients.

Changes in both hemiplegic and nonhemiplegic gastrocnemius muscle bellies are nonspecific and most likely due to inactivity.

Age does not influence passive elongation properties of a normal gastrocnemius muscle whereas inactivity does appear to be a factor.

The only difference between hemiplegic and nonaffected muscle bellies was found during active and passive plantar flexion. At the beginning of passive or active plantar flexion, the hemiplegic foot is already in plantar flexion and total ROM is therefore reduced.

Spastic muscle belly shows smaller length changes and ROM with minimum passive tension, and relatively large ROM and muscle belly changes with maximum passive tension, though the total ROM and muscle belly change was found to be the same in hemiplegic and nonhemiplegic legs.

APPLICABILITY: Effective prevention and management of joint contracture is a question that is raised daily on Rehabilitation Medicine Services, or any other medical service dealing with chronically sick and disabled patients. The scarcity of published data in the Rehabilitation Medicine literature leads one to believe that much of the conservative and surgical treatment is done on an empirical basis. Knowledge about the basic mechanism of how live muscle becomes permanently shortened if not used would enlighten our conservative and surgical treatment of joint contractures.

063 Footwear and Posture: Phases I-V

Principal Investigator: Barbara J. deLateur, M.D.
Status: Continuing
Dates: June 1974-October 1978
Cost: Annual $32,417 — Projected Total $37,812
RT Annual $28,994 — RT % of Annual Total 89%
Annual Report Reference: #16, Page 149, R-107

OBJECTIVES:

Phase I: To study quantitavely what effect the heel height of footwear has on the lumbar lordosis when subjects are standing.

Phase II: To study quantitatively what effect the heel height of footwear has on the lumbar lordosis, the hip, and knee, when subjects are walking.

Phase III: To determine the short-term effects of heel height upon the angles between the bones of the foot (especially the longitudinal arch).

Phase IV: To determine long-term beneficial or detrimental effects of negative heel footwear upon the feet and back.

Phase V: To determine metabolic demands of different types of footwear.

METHODOLOGY:

Phase I: Polaroid photographs were taken with subjects in bare feet, low heels, and earth shoes (men); or bare feet, high heels, and earth shoes (men); or bare feet, high heels, and earth shoes (women).

Lateral photographs were repeated five times in each position and the average intersecting angles and the standard deviation made. Kottke landmarks on the anterior superior iliac spine and posterior superior iliac spine were placed and a tape drawn between those landmarks. To that line a perpendicular was dropped to the greater trochanter. Also, a tape was placed connecting the lateral epicondyle of the femur with the greater trochanter. Thus, the true angle of the hip was measured and recorded. This served as an orienting landmark for the photography, to aid in reproducibility of the method.

Phase II: Electrogoniometry will be used to measure the angles of the low back, the hips, knees and ankles instantaneously throughout the gait cycle with subjects in bare feet (providing the nermative data), negative heels, and positive heels of various heights.

Phase III: Subjects with normal or hypermobile flat feet will have cineradiographic films made of their feet as they walk on the treadmill in bare feet, negative-heel and positive-heel footwear. These motion-picture X-Rays permit statistical analysis of the angles between the bones of the feet at all phases of the gait cycle of normal and flat feet in the various footwear to determine whether the long arch is "levered open" in negative footwear.

Phase IV: A simple questionnaire regarding type of shoes worn most of the time and presence or absence of back pain and/or footpain is filled out by telephone. Subjects are telephoned every six months for a minimum of two years.

Phase V: Oxygen consumption studies will be made of subjects in bare feet, negative-heel shoes, low-heeled shoes of comparable weight, and high heeled shoes, at varying level speeds, and with varying inclines on the treadmill.

FINDINGS TO DATE: The new "exoskeleton" setup has been built to measure hip, knee and ankle angles. This new system, developed by the University of California at Berkeley, it being used together with RT-3's back-angle measurement device. Two pilot subjects have been run and the first of six experimental subjects has also been run. The system is self-aligning and moves parallel to chosen body segments. The exoskeleton is attached to potentiometers which record voltage changes, and as the subject walks, the computer converts voltage changes to changes in degrees of motion.

APPLICABILITY: Mechanical or postural low back pain is associated with bad posture — mainly increased lumbar lordosis. High heels are said to increase this lumbar lordosis and aggravate such low back pain (although the published studies do not fully document this). Negative heel shoes, on the other hand, have a flat heel and are raised in the front, thus are said to improve the posture, so claim the manufacturers of the shoes. If negative heel shoes decrease the lumbar lordosis, they might be able to help postural low back pain.

Consumers of the results will be very widespread. A large number of students are wearing negative heel shoes. Until the results of Phases II, III, and V are in, no specific recommendations will be made. The results of this study will result in clearer concepts of use to the practicing physiatrist, orthopedic surgeon, and general practitioner of the effects of shoe-wearing on mechanical low back pain.

064 Control of Spasticity with EMG Biofeedback in the Incomplete Spinal Cord Injured Patient

Principal Investigator:	**Jeffrey C. Steger, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1975-April 1979**	
Cost:	**Annual $11,500** **RT Annual $10,925**	**Projected Total $25,000** **RT % of Annual Total 95%**
Annual Report Reference:	**#16, Page 257, R-119**	

OBJECTIVES: To determine the efficacy of surface electrode EMG feedback for decreasing spasticity in incomplete spinal cord lesions (where control may be possible).

METHODOLOGY: The effects of biofeedback will be determined by A. Monitoring surface EMG activity near the site of the spasm and providing visual or auditory feedback designed to enhance increased muscle relaxation in that area. B. Measuring spasticity (mean clonic frequency assessed in a standardized procedure – see methods) before and after feedback training to evaluate the extent of its change associated with decreased surface level EMG activity. C. Examining personality characteristics and mood before and after feedback training to determine the psychological impact of learning this self control procedure. D. Correlating changes in mood and personality characteristics with objective changes in EMG readings, spasticity change scores, subjective ratings of spasticity by the patient, and objective changes in range of motion, ADL capabilities, and activity levels.

FINDINGS TO DATE: While awaiting delivery of equipment, assessment tools and specific techniques for measuring spasticity have been refined. Pilot trials have been performed with a stabilimeter which straps onto a limb and measures jiggling. Initial review of pilot data suggest that this method covaries reliably with measures of surface level EMG activity in the quadriceps and gastrocnemius during spasms. These impressions need to be studied over actual treatment trials before their authenticity can be affirmed.

APPLICABILITY: This research may be of real benefit for spinal cord injured who suffer from the secondary disability of spasticity. Spasticity frequently interferes with transfer ability and ability to concentrate on work tasks therefore interrupting vocational and educational goals, and plans. Frequently, the only method available to control the frequent spasms in the legs is heavy medication which causes loss of alertness. A simple treatment technique such as this one, if effective, might be most helpful in helping spinal cord clients return to work.

065 Rehabilitation Indicators: A Method for Enhancing Accountability

Principal Investigator:	**Wilbert E. Fordyce, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1974-October 1979**	
Cost:	**Annual $3,392** **RT Annual $862**	**Projected Total $750,000** **RT % of Annual Total 25%**
Annual Report Reference:	**#16, Page 458, R-125**	

OBJECTIVES: To develop a set of multi-dimensional (ADL, Vocational, Social) rehabilitation indicators that will be applicable to a broad range of disabilities (physical, sensory, MR, psychiatric), and in many types of settings (VR, medical rehab, VA, sheltered workshops, etc.).

To enhance accounting for the multi-phasic nature of rehabilitation services by developing indicators that can be used at various points in time.

METHODOLOGY: Rehabilitation indicators will be developed by each of three factor relevant task forces (ADL, Vocational, Social) that meet the following criteria:

a. Items are to be behavioral descriptors, and
b. Relevant to goals of clients and rehabvilitation settings, and
c. Graded, scalable and potentially measurable, and
d. Potentially modifiable (behaviors have 'range'), and
e. Generalizable across sets of clients, not idiosyncratic.
f. The placement of each item must be defined within the hierarchy of the branching system.
g. The behavior described by the item must be consistent and reproducible.

Rehabilitation indicators may be used to develop client profiles, from which a weighting system may be derived. This proposed weighting system would assist in defining severity of disability functionally and also in helping to develop a weighted closure system.

The developmental phase of the Rehabilitation indicators project is in its final stages. Two indicator Sets, Social/Leisure and ADL-Mobility, have been completed. The former has been receiving extensive field testing within RT-3 during the past year. Two additional sets, Vocational, and Environmental Status Indicators, are nearing completion.

FINDINGS TO DATE: Progress regarding the overall project will be reported from RT-1. Progress with respect to the development and testing the Activity Indicator instrument will be described as it has occured primarily in RT-3.

In the past year, the Activity Form has been administered to 188 subjects who are either chronic pain patients or spouses of such patients. An additional set of stroke patients (48) and spouses of stroke patients (40) have also been administered the form. Those data have been keypunched and are in the computer. Preliminary inspection of the results indicates the form discriminates reliably between, for example, male pain patients and their female spouses, male from female pain patients, and male from female spouses in regard to frequency and/or time distributions of a number of common daily activities (e.g. homemaking, resting/napping, visits by relatives, home maintenance and repairs). Differences between stroke and chronic pain patients are even more striking.

A more detailed evaluation is underway of these preliminary "field testing" findings.

APPLICABILITY: The product of this project will be responsive to the increasing demand for accountability, demand based within federal mandates, third party payers, consumer groups and individual clients.

The product will be relevant to providers of services in meeting the demand, in that present accounting systems are inadequate in justly describing input, process and outcomes of rehabilitation.

066 Quadriceps Pacing, Phase III: Relative Effects of Dynamic and Static Exercise Programs on Maximal Isometric Strength and Motor Unit Synchrony

Prinicpal Investigator:	**Barbara J. deLateur, M.D.**	
Status:	**Continuing**	
Dates:	**July 1977-October 1978**	
Cost:	**Annual $35,573** **RT Annual $31,893**	**Projected Total $42,500** **RT % of Annual Total 89%**
Annual Report Reference:	**#16, Page 438, R-126**	

OBJECTIVES: The first objective is to compare the increase of static strength resulting from different training conditions.

1. a fatiguing task, mixed (dynamic with a hold) versus no exercise
2. a fatiguing task, mixed, versus a nonfatiguing (paced) dynamic task of equal mechanical work
3. a fatiguing task, mixed, versus a fatiguing static task (decay of tension to 80% of initial force)
4. two fatiguing static tasks (decay of tension to 80% of initial force versus decay of tension to 20% of initial force)
5. a fatiguing pure dynamic task versus no exercise
6. a nonfatiguing brief maximal static force versus no exercise

A second objective is to compare the effects of the above types of exercise on the synchrony of motor-unit firing, and to establish whether there is a correlation between the increases in muscle strength with the increases in synchrony.

METHODOLOGY: Thirty subjects will be randomly selected from a population of healthy, sedentary young adult males. Subjects will be chosen who are not in an active physical training program.

At the beginning of the study and every two weeks thereafter for twelve weeks, the maximal isometric force of each quadriceps will be measured on a strain gauge. Subjects will be divided into six groups of five and will perform the tasks listed above. Since subjects are assigned randomly from a relatively homogenous group, this should eliminate major initial differences between groups. However, the most conservative comparisons are from leg to leg within the groups. These latter will be the principal base for comparison.

The dependent variable in all cases is the rate of change of maximal isometric force and the rate of change in the synchronization ratio. Maximal isometric force on both sides will be measured at 90, 60 and 15º flexion on days 1, 11, 21, 31, 41, 51, 56, 57, 58, 59, and 60. This is every ten days sessions during training and on the final five days when there is no training. Motor unit synchrony will be measured on days 1, 28 and 55 (the beginning, midpoint and end of training).

FINDINGS TO DATE: Six subjects have completed this study and fourteen more are now participating. The data collected so far do not suggest large increases in muscle strength as a result of the training programs of groups 1-5 (no subjects in group 6 have completed the study yet). However, the significance of any changes cannot be assessed until all subjects have completed the study and analyses of variance are done.

APPLICABILITY: The single largest amount of time in any spinal cord injured patient's rehabilitation program is spent on strengthening exercise, with the intent of giving patients not only strength but also ksills they need for their daily living demands.

It is not known whether there is any exercise program with applicability to all the tasks required of spinal cord injured patients. There is evidence in the literature both for some degree of specificity and some degree of interchangeability in exercise programs. Current practice is to prescribe dynamic exercise (high forces or low) as if it were universally applicable. In order for the patient to learn most efficiently to perform given tasks, it would be useful to know how specific a given exercise program is; at the same time training for each and every task would be expensive and time consuming. The information learned from this study will help the physiatrist to prescribe the most effective type of exercise.

067 Functional Distinction Between Neural Systems Involved in the Disabilities of Parkinson's Disease

Principal Investigator:	**Marjorie E. Anderson, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1976-September 1979**	
Cost:	**Annual $8,803** **RT Annual $8,803**	**Projected Total $25,361** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 378, R-127**	

OBJECTIVES: To determine the tonic firing pattern of antidromically-identified nigro-striatal and nigrothalamic neurons during active postural stabilitation in awake monkeys. The hypothesis is that nigrothalamic neurons will show a regular tonic firing pattern in this paradigm and that nigrostriatal neurons will show a pattern that is sufficiently distinct such that they can be identified on the basis of this pattern.

METHODOLOGY: Juvenile monkeys (M.mulatta or M.fascicularis) will be trained to maintain a stable head position, in which a light beam from an overhead source is reflected by a skull-mounted dental mirror into an overhead photo-detector cell. Maintenance of this position for the required number of seconds results in delivery of cold applesauce reward from a tube mounted in front of the animal, and colored signal lights and presence or absence of a tone indicate "on" vs. "off" position to the animal. The animal's food intake outside the training time is reduced during initial training, but he is not allowed to go below 80% initial body weight at any time, and after initial training, is fed enough to insure a normal growth rate for these immature animals.

At a later time, using a technique adopted by others (D. Bowden, E. Fetz) at the Regional Primate Center and satisfactorily tried by us in one preliminary monkey, stimulating electrodes can be positioned in an awake, behaving animal during recording from the structure under study. This kind of arrangement will be used to allow optimum positioning of electrodes for antidromic excitation of thalamic-projecting nigral neurons from VAmc and VLm, and of nigrostriatal fibers, as they course dorsolaterally in the vicinity of the sub-thalamic nucleus and along the medical border of the internal globus pallidus.

The activity of single neurons in the substantia nigra will be recorded with electrolytically-sharpened tungsten electrodes, insulated except at the tips, which are covered with electrolytically deposited iron particles to improve recording characteristics. The recording electrode is back-fed into a sterile hypodermic cannula, which is inserted through a calibrated R-O adapter, penetrates the silastic and dura, and extends to a position approximately 5-8mm. above the substantia nigra. The electrode is advanced through the cannula with a hydraulic micromanipulator, and the tonic activity of all isolatable units expected to be in the vicinity of the substantia nigra is recorded. Following acquisition of data during 1-2 minutes of stable, on-target behavior, a unit will be tested for antidromic activation from each of the stimulating electrodes described above. Criteria for antidromic activation will be:

(1) ability to respond faithfully to each stimulus in a train of 5 stimuli delivered at 500/sec.

(2) constant latency, using just supra-threshold stimulus intensities, and

(3) collision with "spontaneous" action potentials, such that failures will occur if the time between the "spontaneous" potential and the stimulus is less than the evoked potential latency plus the refractory period. Threshold stimulus intensities will be determined for each electrode and used to assess the probability of stimulus spread to the other (nigrothalamic or nigrostriatal) system.

Amplified neuronal activity, the output of a stimulus intensity monitor, and logic pulses indicating feeder delivery and "on" vs. "off" head position will be recorded on tape with an Ampex 1800 L analog record. Small electrolytic lesions and deposits of the plated iron particles will be made at known electrode tip depths relative to the top of the microdrive adapter in several tracks, to allow later reconstruction of recording positions for all neurons.

Following experimental procedures, animals will be anesthetized deeply with sodium pentobarbital and perfused with saline and formalin. The brain will be removed and fixed, frozen sections will be cut and stained with cresyl violet and with potassium ferrocyanide to elicit the Prussian blue reaction with the deposited iron particles. Recording positions will be reconstructed by reference to identified lesion-iron marks made at known positions and mapped on a standardized set of sections.

Firing patterns of neurons will be described in terms of interspike interval analysis done off-line with taped data using existing programs for the Honeywell DDP 516 computer.

This study will require 2-4 monkeys, depending on whether or not data can be collected bilaterally.

FINDINGS TO DATE: This project was initiated on the basis of preliminary data gathered on two monkeys and presented at the Neuroscience meetings. In addition to completing the analysis of those data, during the five months we have trained another monkey and surgically implanted the chamber and stimulating platform, so that he is now ready for recording.

To summarize our preliminary data to date, we have found neurons in the substantia nigra that exhibit two basic types of firing patterns when the animal actively maintains a stable head position. All of those clearly located in the pars reticulata region of the substantia nigra (N=21) had regular, high frequency discharge patterns, similar to those reported previously for globus pallidus neurons. The pars compacta region of the substantia nigra, which is smaller and interdigitates with pars reticulata, contains cells of nigrostriatal system and included some neurons with this high frequency, tonic discharge, as well as others with a slow frequency burst pattern. In the initial animals we did not have an adequate set-up to stimulate these cells antidromically, but the data to date would indicate that the nigrothalamic cells probably do have the tonic high frequency pattern and that the pattern for the nigrostriatal neurons may or may not be of the burst type.

Data from the last animal support those gathered from the first two. That is, there are two general types of firing patterns recorded from substantia nigra neurons, a tonic high frequency pattern and burst pattern. We did succeed in firing a few neurons antidromically from our stimulating electrodes near the caudate nucleus, and the few fired seemed to have an irregular tonic pattern. This is consistent with our hypothesis that the nigro-striatal neurons can be distinguished from the nigrothalamic neurons, which we hypothesized would have regular high frequency discharge. However, due to technical problems, we have not yet fired enough neurons antidromically to be confident that this difference is consistent.

APPLICABILITY: Parkinsonian patients would benefit from therapy based on an improved understanding of how the basal ganglia operate in assuring appropriate motor control.

068 Modification of Speech Patterns of Normal and Dysarthric Speakers as a Function of Four Rate Control Strategies

Principal Investigator:	**David R. Beukelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**December 1976-December 1978**	
Cost:	**Annual $10,748** **RT Annual $10,748**	**Projected Total $22,224** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 278, R-128**	

OBJECTIVES: The objectives of this study are to determine the durational, intonational, and stress pattern changes of normal and dysarthric speakers, who are instructed to control their speaking rate through four strategies (1) external pace stimulus provided by the experimenter (2) concurrent external pace stimulus provided by the speaker (3) momentary pause between each word and (4) completion of an utterance within an allotted time. The relationship between speech intelligibility of dysarthric speakers and rate control strategies will be studied.

METHODOLOGY:

1. Normal adult speakers and dysarthric speakers, who speak with less than normal intelligibility, will be included in this study. Ten normal speakers will be included in the first phase of the study, and twenty dysarthric speakers in the categories of ataxic dysarthria and hypokinetic dysarthria will be included in the second phase of the study.
2. During the first phase of the study each speaker will be audio recorded as he produces four sample sentences under one control and four experimental conditions. During the control recording session the speakers will be instructed to read sentences in their habitual conversational manner. The criterion rates under each experimental task will be 60 words per minute, 100 words per minute, and 140 words per minute. During each of the experimental recording sessions, the speakers will be instructed to control their rate according to one of the specific rate control strategies listed under the objective section of this proposal. (1) **External pace stimulus** (2) **Concurrent external pace stimulus provided by the experimenter** (3) **Momentary Pause** (4) **Time Allotment.** Speakers will be permitted to practice various speaking rates with material other than the target material of the study. When they are speaking at criterion rates, the target sentences will be presented and recorded. Each of the four experimental recording sessions will occur on a different day, so that the learning effects on the speaking performance of the subjects will be reduced. The order of the speaking rates under each experimental conditions will be randomly selected.

   Speech samples will be selected such that each potentially will include a unique stress or intonation pattern. Stress and intonation patterns planned are (1) primary stress first word of sentence (2) primary stress last word of sentence (3) sharp raising intonation last word of sentence and (4) gradual rising intonational pattern throughout the sentence.

   All speech samples will be recorded on an audio tape recorder, with the microphone placed 10" anterior to the lips of each speaker. The primary acoustic analysis will be completed by an experimental program on a PDP 11 computer. This program simultaneously analyzes fundamental frequency (pitch), intensity (loudness), and the durational aspects of speech and silence during an utterance. From these data that following observations will be taken. (1) Speaking rate, (2) percentage of total utterance time given to pauses, (3) percentage of total utterance time given to articulation, (4) description of the fundamental frequency (intonation) contour and (5) description of the loudness contour.

3. Phase two of the study which includes dysarthric speakers from the ataxia and the hypokinetic groups will be very similar to phase 1 with the following exceptions: (1) the rate conditions (60, 100, 140 words per minute) may not be required of all patients. An attempt will be made to have the dysarthric person speak at as many of these rates as is possible. Also, they will be asked to speak at approximately 60 and 40 percent of their conversational rate. Also (2) the speech intelligibility of each dysarthric speaker for each sentence recorded will be judged on the 7 point scale. The tapes will be rated by three judges.
4. The entire tapes of two normal speakers, two ataxic and two hypokinetic dysarthric speakers will be acoustically analyzed a second time for reliability purposes. The tapes of two ataxic and two hypokinetic dysarthric speakers will be rated for intelligibility a second time for reliability purposes.

FINDINGS TO DATE: Data have been collected from 6 normal speakers and 3 dysarthric speakers. Softwear changes have made the pitch analysis program unreliable for much of the past year. Additional equipment is on order which will permit more accurate durational measurements.

APPLICABILITY: The treatment plan of most dysarthric patients include a modification of speech rate, although many authors recommend that the speech rate of certain dysarthric speakers be reduced, and some authors suggest strategies to achieve this purpose. Information about the effectiveness of this strategy has not been determined. The information gathered in this study will be used extensively to select treatment strategies designed to modify the speaking rate of dysarthric speakers.

069 Respiratory Function of Quadriplegic Individuals: Influenced by Glossopharyngeal Breathing Training and Periodic Long-Term Follow-Up*

Principal Investigator:	**Rosemarian Berni, R.N., M.N.**	
Status:	**Continuing**	
Dates:	**December 1976-December 1979**	
Cost:	**Annual $9,332** **RT Annual $8,412**	**Projected Total $21,000** **RT % of Annual Total 90%**
Annual Report Reference:	**#16, Page 285, R-130**	

*For the purpose of closer coordination two approved projects have been combined, namely: Influence of Lesion Level, Time of Onset, and Glossopharyngeal Breathing Treatment on Vital Capacity Measurement of Quadriplegic Patients and Periodic Evaluation of the Respiratory Function of Discharged Quadriplegic Patients.

OBJECTIVES:

1. To compare assisted (with GPB) and unassisted vital capacity measurements generated by quadriplegic patient spinal cord injuries at C4-5, C5-6 and C6-7 respectively.
2. To compare change in unassisted vital capacity measurements which occur as one group of quadriplegic patients receives GPB treatment and another group of quadriplegic patients receives no treatment.
3. To compare assisted and unassisted vital capacity measures taken during long-term follow-up.
4. To describe personal respiratory maintenance program after discharge.

METHODOLOGY: All subjects included in this study will be classified as quadriplegic due to functionally complete cervical cord lesions. No subject with known respiratory impairment other than related to quadriplegia will be included. 20 subjects will be included in Group 1 — GPB treatment and 20 subjects will be included in Group 2 — non-GPB treatment' will be matched according to a) sex b) time since onset c) age and d) height.

GPB treatment will be delivered once daily for 20 minutes to subjects included in Group 1. Assisted vital capacity measurements and unassisted vital capacity measurements (the maximum measurement during 3 trials) will be taken once weekly from the patients in the treatment group. Unassisted vital capacity measurements will be taken once weekly from the control group. All measurements will be taken in the supine position, since data collection will begin before some of the subjects are able to sit. Glossopharyngeal breathing treatment will be terminated for subjects in the treatment group when the assisted vital capacity measurement does not improve more than 50 cc during a 2 week time period. Data will be collected from each control subject during a time interval equal to that spent by his matched treatment subject in the glossopharyngeal breathing treatment program.

Following discharge from the Rehabilitation program assisted and unassisted vital capacity measurements will be taken at 3 month intervals. At each interval, the quadriplegic person will be asked to answer a questionnaire designed to explore his respiratory maintenance program. The follow-up data will be taken by a registered nurse, who will be trained by the primary treatment staff to reliably measure (.95) assisted and unassisted vital capacity.

Those patients in the study population who continue the respiration maintenance program and those who fail to continue the program will be followed after discharge from the hospital.

The rehabilitation nurse will obtain respiratory measurements with the subjects in recumbent and sitting positions. The best effort the patient obtains in any testing series is the value used for vital capacity.

The mean of ten consecutive tidal breaths will be utilized for the measurement of tidal volume.

During the review of this project when it was initially proposed, the question was raised why a speech pathologist was involved in this study. At University of Washington Hospital glossopharyngeal breathing techniques are taught to quadriplegic patients by the speech pathology staff.

[1] Quadriplegic patients included in the control group will receive GPB treatment prior to their release from the hospital, however, the initiation of their study will be delayed until data is collected for the present study.

FINDINGS TO DATE: Thirteen quadriplegic persons have completed the glossopharyngeal breathing treatment program and the inpatient data have been completely collected from these subjects. The followup data is taken by a registered nurse trained by the primary treatment staff to reliably measure (.95) assisted and unassisted vital capacity. Unfortunately two respirometers were defective. The delay has resulted in data from one patient; the nurse is in the field testing additional patients now.

APPLICABILITY: The results of this study will assist members of the rehabilitation team as they seek and select training procedures designated to increase respiratory capacity of quadriplegic patients with various time of onset and various lesion levels.

Expected consumers' use of findings:

a. Better respiratory maintenance.
b. Better overall body system function.
c. Better potential for employment.
d. Better opportunity to prevent physiological and psychological deterioration and increased cost to the consumer or the taxpayer.

070 Measurement of Musculature Blood Flow Induced by Microwave Diathermy

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**Continuing**	
Dates:	**August 1976-August 1980**	
Cost:	**Annual $26,102** **RT Annual $22,778**	**Projected Total $77,645** **RT % of Annual Total 87%**
Annual Report Reference:	**#16, Page 107, R-131**	

OBJECTIVES: To ascertain the quantitative relationship between doses of microwave diathermy and deep musculature blood flow increase and rate change.

METHODOLOGY: The utilization of clearance rate of radioisotopes from tissue beds as an index of their blood flow has long been done both clinically and experimentally. In the present study the wash-out of injected Xe^{133} a method particularly useful in the measurement of skeletal muscle blood flow 2, 3, 4, 5, will be employed using the human thigh for the diathermy paradigm. The geometrical dispersion of the injected Xe^{133} depot will be imaged by means of a gamma ray camera interfaced with an on-line computer having disk memory allowing replay of the depot clearance event and separate analysis of different regions of interest in time and space. The wash-out image coupled with the measurement of the radioactive clearance by means of scintillation counter will give a quantitative picture of the thigh blood perfusion rated. In addition, the microwave diathermy process comprising both the absorbed energy distribution and the responding blood flow field will be modeled with a finite element digital computer thermal analyzer[*] to define the range of most probable models describing the physiologic response of the thigh to this process. This computer model will consolidate information from a) previous and ongoing tissue substitute model energy deposition experiments, b) transient human thigh temperature data obtained **in vivo** during diathermy application, c) anatomical details regarding the thigh's geometrical distortion under the weight of the direct contact diathermy applicator; those details obtained from cadaver thigh specimiens and d) the aforementioned Xenon blood clearance experiments.

I. Xe^{133} CLEARANCE EXPERIMENTAL PROCEDURES

A. Preliminary Sessions:

Prior to the actual isotope wash-out experiments, the experimental subjects are to be familiarized with the general procedures to be followed during the experiments. In addition, X-rays of both thighs from the lateral aspect will be taken to determine the anatomical dimensions relevant to the thigh diathermy problem; i.e. thickness of the anterior layer of fat, location of the femur relative to the anterior thigh surface and the distortion of the thigh profile (again due to the weight of the diathermy applicator and the seated posture of the subject) are to be measured. This session will last approximately 30 minutes per subject.

B. Blood Flow Experiments:

The blood flow measurements will be performed under a variety of conditions and as such the overall study is divided into the following eight experiments. Each injection of the isotopic Xenon solution (Saline and Xe^{133}) will be performed with a very fine hypodermic needle (27-31 gauge) and the volume will, in each case, be 0.1 ml, with a radiactivity (specific activity) of approximately 1 millicurie per cc. All measurement sessions will be preceded by a rest period in which the subject will be recumbent and rested comfortably for a period of 30 minutes.

Exp. 1. **Preliminary Xe133 Washout Measurements**

Injection of the radioisotope will be performed at a depth of 1.5 cm in the upper third of the anterior aspect of both resting thighs with the subject supine. Both legs will be monitored for isotope wash-out, one by gamma camera and the other by scintillation probe. The wash-out decrement (Slope of the log-plotted count rate vs. time) of these instruments will yield the local value of blood flow rate at the respective sites of injection. The clearance rate will be monitored to determine the time period over which a significant gamma ray count can be detected (not to exceed one hour). One or two deeper injection depots will also be employed in identical experiments to ascertain the effect of tissue attenuation on the maximum useful (i.e. measureable) wash-out period.

Exp. 2. **Xe133 Washout with Diathermy Heating and Air Cooling**

This experiment is identical to the preceding Exp. 1 with the following exception: after approximately 15 minutes of imaging/counting the thigh under the camera will be cooled for five minutes (with the camera removed) with an air-cooled direct contact diathermy applicator and subsequently heated with this device (with concurrent cooling) for 20 to 30 minutes or until such time that subject discomfort warrants cessation of heating. Immediately after this diathermy application the gamma camera will be repositioned over the thigh and the wash-out site monitored for blood flow as long as it remains measureable. The opposite thigh will be continuously and simultaneously observed by scintillation probe during the entire experiment to provide a control measurement as well as an opportunity to study the countralateral perfusion effects of diathermy performed on the opposite limb.

Exp. 3. **Washout with Diathermy Heating Only**

This part is identical to the methods used in Exp. 2 except that no pre-cooling or cooling during diathermy application will be done.

Exp. 4. **Washout with Cooling Only**

This experiment is identical to Exp. 2 except that there will be no heating phase.

Exp. 5. **Simultaneous Measurement of Blood Flow and Tissue Temperatures**
The **in vivo** measurement of the temperature distribution in a subject's thigh will be done by means of temperature sensors (thermistors) mounted on the tips of long thin hypodermic needles which will be inserted laterally into the thigh such that the sensors underlie the centerline of the diathermy applicator at varying depths in the tissue. Four to six of these sensors will be positioned with the aid of X-ray examination so that the sites of temperature measurement are known. All such experiments employing invasive temperature probes involve the implantation of such probes in only one thigh of each subject. Prior to insertion of these temperature probes Xe^{133} solution depots will be injected in both thighs as described in Exp. 1; the subsequent wash-out will be measured periodically to determine the effect of the probes on the thigh blood perfusion field.

Exp. 6. **Blood Flow and Temperature Measurement with Diathermy Heating and Cooling**
This experiment employs the methods described in parts 2 and 5 concurrently in order to gauge the effect of diathermy heating and cooling on the simultaneous blood flow and temperature fields underlying the diathermy applicator. This method will provide a significant advantage over the previous experiments in that the observed temperature levels will provide a means by which the scintillation counter(s) can be positioned for wash-out determinations at moments of particular interest in the diathermic blood flow response; for example, at the moment of peak flow. This method will also provide a means of investigating whether or not the microwave diathermy process can be utilized to override the cooling effect of augmented blood flow and thereby establish the feasibility of controlling the tissue temperatures such that they are maintained in the "therapeutic range."

Exp. 7. **Blood Flow and Temperature Measurement with Heating Only**
The methods of Exp.'s 3 and 5 will be combined to study the effect of heating only on temperature and perfusion rates.

Exp. 8. **Blood Flow and Temperature Measurement with Cooling Only**
The methods of Exp.'s 4 and 5 will be combined to study the effect of cooling on temperature and perfusion rates.

II. INSTRUMENTATION AND MATERIALS

A. A dual probe, NaI crystal scintillation counter will be used to measure tissue gamma ray emission levels which are proportional to the concentration of Xe^{133} at the injection depot. These measurements yield local blood flow rates.

B. A high resolution, circular field gamma ray camera and companion imaging system will be used to image and count Xe^{133} wash-out in the thigh. This system is connected to a disk memory on-line computer as previously described.

C. A 915 Mhz air-cooled direct contact diathermy applicator that has been designed and tested in our laboratory will be used to heat the thigh. A 915 Mhz General Electric Magnetion has been adapted to allow the operator to vary the output microwave power level from 5 to 100 Watts. The power level used in the experiments will be approximately 40 Watts net. The direct contact applicator has a cold air supply/pump system that permits the operator to select and maintain the desired temperature and flow rate of cooling air. This air system is also instrumented to continuously show the relative humidity of the air stream.

D. A CDC 6400 Digital Computing System and a heat transfer thermal analyzer program developed in conjunction with the University of Washington Department of Mechanical Engineering will be employed in the computer modeling of the thigh diathermy process.

E. Radioisotope: Xenon 133, a very weak-emitting, low energy (gamma ray) radioisotope which has been safely and routinely used for years in clinical and experimental blood flow and volume measurements will be injected in saline solution at specific activity levels of approximately 1 millicurie/cc. It will be injected into the quadriceps through very thin (27-31 gauge) hypodermic needles, too small to cause significant bleeding. The half-life of this isotope is 5½ days, though the Xe^{133} expelled from the body in a matter of minutes through the lungs.

FINDINGS TO DATE: All of the necessary preliminary groundwork has been done; the personnel and equipment have been assembled, the latter with the necessary modifications made. All of the requirements have been met to satisfy the University's Human Subjects Review Committee and the Radiation Safety Committee.

The original protocol has been modified; Xe^{133} will replace I^{125} as the radioisotope of choice. This is because Xe^{133} is easier to work with and is safer for human subjects. In addition, the previously unavailable gamma ray imaging system has permitted a more sophisticated analysis of of the isotope wash-out phenomenon than originally proposed.

The synthetic tissue and computer modeling aspects of the diathermy problem have received much attention in the past year. Rigorous heat transfer experiments on the tissue substitute model surrogate tissue materials have been performed and the resulting material properties are being reported in the literature. As a result of these findings new tissue substitutes have been made which more accurately replicate the human thigh. In addition, the software programs needed for the digital computer model of the thigh have been developed and preliminary results demonstrating the efficacy of this modeling approach have also been reported.

Approximately 20 individuals have been screened in the preliminary session. Three human subjects have been tested in preliminary Xe^{133} blood flow experiments, completing experiment 1, validating the Xe^{133} clearance technique as a method of defining the effect of microwave diathermy on blood flow. It has been found that under resting conditions a significantly measureable radioactive wash-out can be detected for about 45-60 minutes after the Xe^{133} injection and that a post-injection waiting period of 10 to 15 minutes is required before cooling and diathermy may be applied. This time is necessary for the injection trauma (hyperemia) to subside.

The cadaver thigh studies in which frozen cross sections of human thighs were mapped for musculature tissue shape changes under the weight of the direct contact applicator were completed.

APPLICABILITY: The information that will be obtained can be used by engineers to design improved applicators, to test their designs and also by physitrist and physical therapist to prescribe and carry out more effective diathermy treatments.

071 Mapping of Microwave Fields Surrounding Human Subjects under Diathermy Treatment

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**Continuing**	
Dates:	**August 1976-August 1978**	
Cost:	**Annual $41,372** **RT Annual $33,219**	**Projected Total $82,843** **RT % of Annual Total 80%**
Annual Report Reference:	**#16, Page 115, R-132**	

OBJECTIVES: The objective of the study will be to measure and plot contours of equal field intensity around human subjects while they are being irradiated with electromagnetic energy by microwave diathermy equipment operating at 915 and 2450 MHz.

METHODOLOGY:

1. All measurements will be carried out in an anechoic chamber, so precise field intensity levels around the subject can be obtained. Human volunteers of varying physical size will participate in this study. They will be placed in the anechoic chamber in a position which is typical of diathermy treatments. The position of the subject will depend on the area to be treated. Selected areas of the body that are frequently treated with diathermy will be used — tight joints, anterior and posterior shoulder, contractor of the biceps, the lower back and contractors of the thighs. The selected area will be treated with microwave applicator operating at 915 and 2450 MHz.
2. An X-Y-Z co-ordinate tracking system with a National Bureau of Standards energy density probe attached will be shielded and placed in the anechoic chamber. This device will be computer-controlled to follow isobars of power densities with limit switches to set the area that is to be scanned. The computer will position the probe and also plot the field intensity levels in relation to distance from the diathermy applicator. This facility will allow us to make many measurements in a short period, which reduces the time of microwave exposure.
3. Instrumentation will include the following:
   a. National Bureau of Standards power meter: measures the power density in an electromagnetic field. Frequency of 10 MHz-3000 MHz accurate to 1.0 DB.

b. X-Y-Z tracking system. This is a commercially available system that was purchased and modified to be controlled by our Honeywell Computer.

The N.B.S. probe is attached to this system so it can be moved in any of three coordinates. A zero point is set by the operator and this is placed in the computer. A grid is then set up and the computer directs the tracking system to move in the increments defined, 1 cm-2 cm, etc. The computer then moves the probe throughout this grid while recording the power density measurements at each point.

c. Thermistor power meters will be used to monitor the incident and reflected power going to the applicator.

d. Microwave generators operating at 915 and 2450 MHz will be used to supply power to the antennas.

e. The contour lines of power density will be plotted on standard X-Y recorder.

FINDINGS TO DATE: This project was split into two parts. In the first part, the isopower density lines around substitute tissue models were obtained. This included the testing of two diathermy applicators commonly used in clinical use and two prototype diathermy applicators. Four tissue substitute models were irradiated by the diathermy applicators. Extensive measurements of the microwave leakage around the models and applicators were performed. A limited number of human subjects were studied in order to compare the results that were obtained in models to that which was obtained in similar anatomical sites in humans. The thigh, upper arm, shoulder and lower back areas were irradiated with the four diathermy applicators and the leakage levels around the applicators and human subjects were measured. Rapid initial results were required in order to respond to proposed Bureau of Radiological Health Standards.

The second and more detailed part of the study is near completion. Stray radiation measurements are being made around many anatomical sites in humans as they are exposed to various microwave applicators. The areas being exposed are sites that are most commonly treated in the clinic's posterior, lateral neck, anterior and posterior shoulder, upper back (trapezius), biceps, thigh (quadriceps), lower back (lumbosacral area), and elbow. Four subjects (one large, two medium, and one small) were used in the experiment. Four diathermy applicators were tested on the anatomical sites listed above for the two medium-sized subjects. Two of the diathermy applicators were tested at three of the anatomical sites on the large and small subjects. The effect of applicator orientation was tested for each of the cases listed above.

Evaluation of the collected data will require additional work because of the large amount of data collected and the large number of parameters affecting leakage levels. Preliminary results of both parts of the study are summarized below:

Significant differences in stray radiation patterns during exposures of tissue substitute models and corresponding parts of the human anatomy were found with various diathermy applicators.

The measurements of power density leakage for exposure of simple geometric models does not accurately predict the levels measured in corresponding human exposures. In fact it has been demonstrated that diathermy applicators designed to satisfy a proposed diathermy performance standard based on models will not satisfy the same standard if the model is replaced by the actual human anatomy it represents.

In clinical treatment settings, the leakage radiation may be worse than demonstrated by the by the experiments we performed since human volunteers were used who had dimensions similar to those of the geometric models. In the general population there are far greater variations from person to person than between these particular models and volunteers. Other parts of the anatomy used in the second part of these experiments conform even less to the geometrical models proposed for use.

It is also not practical nor has the technology been developed to produce special applicators for each possible human site of therapeutic exposure with the requirement that no significant radiation beyond the 5 cm distance limit from the applicator occur.

An alternative approach to the development of standards would be to mandate that the manufacturer state for his applicators the maximal distance and direction where stray radiation exceeds exposure limits in tissue substitute models both for the E field parallel and perpendicular to the long axis of the models. In addition, standards should allow the use of this equipment only by well-trained operators such as physicians and therapists who would be able to make effective use of the available information to assure safe treatment of patients. For this approach, more experimentation is necessary to delineate which modifications of stray radiation patterns can be uniformly anticipated in the common sites of human exposure.

Certainly, regardless of the approach to the promulgation of standards, direct contact applicators are to be preferred over the non-contact applicators, since high intensity stray radiation is much more contained by these applicators. The more contact the radiating surface has with the skin, the less stray radiation.

Also, the applicators produce an asymmetrical leakage pattern. Therefore the applicator orientation may be used to reduce levels of stray radiation and to direct the radiation away from sensitive anatomical areas: eyes, genitals, etc.

It is evident from this study, that a new project should be initiated in which stray radiation levels should be measured around a large number of individuals. The physical size of the individuals should be varied. This would more accurately determine the changes in the stray radiatiion pattern as different volumes of tissue are placed in the microwave field. The number of anatomical sites irradiated and the number of applicators tested could be reduced to minimize the cost and time commitment of the study.

APPLICABILITY: Findings will be utilized by standard-setting agencies for medical devices, especially microwave diathermy equipment. Findings would also ultimately be used by practitioners.

072 Determination of Basal Ganglia Influences on Other CNS Motor Systems: Development of a Model in which Therapeutic Procedures Can Be Tested

Principal Investigator:	**Marjorie E. Anderson, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1977-September 1979**	
Cost:	**Annual $5,692** **RT Annual $5,692**	**Projected Total $11,380** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 386, R-133**	

OBJECTIVES: To determine, by carefully-controlled stimulation of the substantia nigra and intracellular and extracellular recording from neurons in the thalamus and superior colliculus, whether the synaptic effect of nigral axons terminating on these cells is excitatory and/or inhibitory.

METHODOLOGY: Cats utilized for these experiments will be anesthetized with sodium pentobarbital, alpha chloralose or halthane and nitrous oxide replaced with nitrous oxide after surgical procedures are completed. Because paralysis and artificial ventilation will be necessary to permit intracellular recording, care will be taken to insure that when only N20 and O^2 are administered during recording, the arterial blood pressure remains stable and the pupils are slit as indicators of adequate analgesia. In addition, a long-lasting local anesthetic will be injected around stereotaxic pressure points and skin incisions.

Because neurons in the basal ganglia are particularly susceptible to the depressive effects of general anesthetics such as barbituates, a few experiments might be needed on animals without general anesthesia and with extensive, careful infiltration of wound margins and pressure points with long-lasting local anesthetics.

Suction will be used to remove tissue overlying the thalamus or superior colliculus as deep as the corpus callosum or the dorsal hippocampus. Recording microelectrodes filled with potassium citrate or potassium acetate saturated with fast green will be introduced stereotaxically into the thalamus or superior colliculus to allow intracellular and extracellular recording from neurons in these structures. Ususal procedures, such as pneumothorax, will be done to improve stability.

A stimulating array of 6-9 tungsten electrodes, sharpened electrolytically and insulated to within 0.5 mm of the tips, will be introduced into the substantia nigra and surrounding structures from an angle to avoid mechanical interference with recording electrodes in the ipsilateral superior colliculus (Yoshida, Rabin, and Anderson 1971, 1972). Stimulating electrodes also will be positioned caudally in the contralateral medial longitudinal fasciculus (MLF) so that we can determine whether the neurons studied can be activated antridromically from MLF levels at about mid-pons, where the axons of many collicular efferent neurons would be situated (Altman and Carpenter, 1961; Anderson, Yoshida and Wilson, 1971).

Intracellular recordings of postsynaptic potentials evoked by bipolar stimulation between adjacent electrodes will be taken and threshold stimulus intensities will be determined. The array will include control electrodes situated deep and superficial to the substantia nigra, and to further separate out any responses due to stimulus spead to non-nigral structures, stimulating electrode arrays will be moved with micromanipulators and stimulus threshold intensities for evoked responses will be measured in several neurons with the stimulating array at each stimulus depth to determine points of lowest stimulus threshold. If the data are ambiguous because of possible effects due to stimulus spread, especially to the medial lemnisci that lie just dorsolateral to the substantia nigra at some levels and to the cerebral peduncle just ventral to SN, it may be necessary in some animals to interrupt the pyramidal tract and medial limniscus fibers ipsilateral to planned SN stimulation early enough to allow them to degenerate before the acute experiments.

Intracellularly-recorded data will be supplemented by extracellular records, examining stimulus evoked effects on spontaneous activity or in a conditioning testing format in which the cells response to a test stimulus such as a shock to the contralateral forepaw or to neck muscle nerves is evaluated when it is applied at various intervals relative to a conditioning stimulus to the substantia nigra.

Intracellularly and extracellularly-recorded potentials will be amplified by conventional techniques, photographed with kymograph film, and recorded on FM tape (Ampex 1800L; frequency range DC-5kHz). Averaging and peristimulus time histograms can both be done using existing programs for the Honeywell DDP 516 computer.

Recording sites will be determined by reference to spots made by fast green FCF deposited electrophoretically from the recording electrodes. Stimulus positions will be marked by electrolytic lesions. At the termination of the experiment, the brains will be perfused and fixed in formalin and recording and stimulating positions will be determined from frozen sections. The distribution of responses evoked from different stimulus positions will also be mapped for the superior colliculus.

About 20 cats will be needed for these studies.

FINDINGS TO DATE: During this year, we have recorded from thalamic neurons and have found that stimulation of the substantia nigra **inhibits** thalamic neurons directly. This is analogous to the to the inhibitions produced in other thalamic neurons by stimulation of the other basal ganglia output nucleus, the internal globus pallidus. These data imply that the basal ganglia operate by an inhibitory modulation of thalamic neurons, rather than excitatory modulation, as had been assumed. Furthermore, we have found virtually no convergence of information from the basal ganglia and the cerebellum on individual thalamic neurons, indicating that integration of information from these two sources must occur elsewhere.

Finally, we have demonstrated that some nigral axons going to the thalamus are branches of axons going to the superior colliculus. This forces us to recognize that the basal ganglia may exert a generalized, rather than topographically specific, influence on motor control systems.

APPLICABILITY: Involuntary movement disorders, such as cerebral palsy and other choreoathetoid dyskinesias are a national problem with a large population currently not independent or employable. For example, cerebral palsy has an incidence of about 6 per 1,000. Rational approaches to therapeutic management of these disorders is hampered by our lack of knowledge regarding the relationship of the basal ganglia to subsequent neural "motor systems." The description of the "wiring diagram" for these systems would allow us to test pharmacological and other therapeutic methods for modifying or compensating for dysfunction in these systems.

University of Washington

073 Evaluation of a Circular Polarized Microwave Diathermy Applicator

Principal Investigator: **Justus F. Lehmann, M.D.**
Status **Continuing**
Dates: **June 1977-June 1980**
Cost: **Annual $10,699** **Projected Total $53,496**
RT Annual $7,274 **RT % of Annual Total 68%**
Annual Report Reference: **#16, Page 122, R-134**

OBJECTIVES: To evaluate a recently designed diathermy machine which selectively heats muscle and joints covered with minimal amounts of soft tissue which will be compatible with federal safety regulations as set forth by the Bureau of Radiological Health.

METHODOLOGY: A circular waveguide apertude-type applicator operating at a frequency of 915 MHz has been developed for use as a diathermy applicator.

Various tissue substitute models will be constructed using a new fabrication technique which is being developed in a related study (R-135). The models will be irradiated with the circular polarized applicator at high power for short periods of time. Thermograms will be taken and processed by computer to produce thermographs showing the temperature distribution throughout the model. From this data, the rate of absorption of energy (W/kg) in the various tissue layers can be calculated. This will allow the effectiveness of the applicator in heating various types of tissue to be determined. After the energy absorption pattern is determined in the model, human volunteers will be used to determine actual temperature distribution.

FINDINGS TO DATE: A new 2450 MHz circular polarized direct contact applicator with a quarter wavelength choke flange (manufactured by Transco, Inc.) was tested on a planar bi-layered tissue substitute model. The planar model consisted of a 2 cm solid fat layer over a 10 cm muscle layer. The muscle layer was constructed such that it could be split in half. Three types of thermograms were used to evaluate the performance of the applicator: 1. scans of the fat surface; 2. scans of the muscle surface at the fat-muscle interface, and 3. cross-sectional depth scans of the muscle. Cross-sectional depth scans of the fat cannot be made until an adequate material has been developed for use at the interface of the two halves of synthetic fat tissue (R-135).

The results show that the 2450 MHz applicator produces an oval heating pattern at a given depth in the tissue. This indicates that an elliptically polarized wave rather than circularly polarized wave is radiated from the waveguide aperture.

The depth of penetration of energy into the muscle tissue is very poor. This is due to the high loss of the muscle tissue at 2450 MHz. Finally, the ratio of peak heating in the fat to peak heating in the muscle is quite high. Therefore the temperature of the skin and subcutaneous fat will be elevated to the pain threshold before the muscle tissue temperature is in the therapeutic range.

The 915 MHz circularly polarized applicator which was developed in our laboratory was tested using the thermographic techniques described. The results show that the depth of penetration of energy into the muscle tissue is twice the depth of penetration of the 2450 MHz applicator. The ratio of peak heating in the fat and peak heating in the muscle tissue is half the ratio for the 2450 MHz applicator. Finally, the heating pattern at a given depth in the tissue is circularly symmetrical, producing a uniform heating distribution in the muscle tissue.

Work is continuing on refining the technique of modeling tissue substitutes. The remainder of the testing cannot be completed until the synthetic fat tissue interface problem has been resolved.

APPLICABILITY: Diathermy is a type of therapy designed to treat the most severely disabling sequels of diseases leading to joint contractures. It is also anticipated that this may be of significance in the treatment of such serious disease entities as polymyositis. This treatment procedure is one that could be put into practice in hospitals throughout the United States.

074 The Natural History of Peripheral Neuropathy in Chronic Renal Failure: A Multivariate Clinical and Electrophysiological Study

Principal Investigator:	**Eugen Halar, M.D.**	
Status:	**Continuing**	
Dates:	**July 1977-July 1979**	
Cost:	**Annual $5,225** **RT Annual $3,025**	**Projected Total $12,000** **RT % of Annual Total 58%**
Annual Report Reference:	**#16, Page 362, R-144**	

OBJECTIVES: To study the natural history of motor and sensory involvement in renal patients, paying special attention to changes occuring before dialysis and during the first two years of dialysis. Electrophysiologic and clinical parameters will be correlated with amount of dialysis.

METHODOLOGY: Each patient will be simultaneously evaluated in three different areas. One area of study will involve an ongoing laboratory examination of the state of the patient's renal disease. Another area of study will involve electrophysiological measurement of motor and sensory nerve conduction velocities and H-reflex latencies. The final area of study will involve the assessment of muscle strength and sensory modalities, as well as the level of general physical function.

By repeating complete measurements every three months for the first two years of treatment, and by including some subjects who have had dialysis treatment for several years, we will be able to present a more complete picture of the natural history of motor and sensory function. We will attempt to correlate the factors and offer suggestions for determining the optimum frequency of dialysis to preserve nerve function in dialyzed patients.

FINDINGS TO DATE: Initial studies on 32 uremic patients and 10 normal subjects have been performed. From these studies, analysis of data on uremic patients showed significantly prolonged H-reflex latency values which correlate statistically to findings of slowed nerve conduction velocities in lower extremity nerves. Using Z score analysis, percentile changes in parameters tested are being analyzed to find the most sensitive index in assessment of neuropathy. Electrodiagnostic tests are being found to be more sensitive indicators of early neuropathy than the clinical tests. Our early data indicate that H-reflex latency is the most sensitive of the electrodiagnostic tests, and the sural sensory nerve to be more severely involved than peroneal and tibial motor nerves. Vibration perception threshold appears to be the only clinical parameter being followed that demonstrates value in assessing uremic neuropathy. Further study and analysis will be done.

APPLICABILITY: Information from this project would be used by practitioners treating renal dialysis patients to help them choose the appropriate frequency of dialysis. Since this information would help members of the rehabilitation team make the most efficient use of facilities for treatment and rehabilitation of renal patients, it would help lower the costs to the public at large.

075 Development of New Phantom Material for Testing Diathermy Applicators

Principal Investigator:	**Justus F. Lehmann, M.D.**	
Status:	**New**	
Dates:	**July 1977-July 1980**	
Cost:	**Annual $10,334** **RT Annual $8,402**	**Projected Total $44,000** **RT % of Annual Total 81%**
Annual Report Reference:	**#16, Page 129, R-135**	

OBJECTIVES: The objective of this project is to develop a new phantom fat tissue, eliminating interface problems, that could be used to test and evaluate any type of diathermy applicator over a large frequency range.

Once these models have been developed they can be built to duplicate certain parts of the body that are frequently exposed to electromagnetic radiation. While these models are being irradiated, power density measurements around the models can be made to determine the amount of stray radiation being produced by various applicators. This is important to know to insure the safety of the patient and operator.

These models would also yield patterns of relative heat so that energy absorption in them could be calculated. The heating patterns would also be used to identify areas of maximal heating which would be used to select the applicator that would heat the area of pathology.

METHODOLOGY: The initial design approach will be the development of a new phantom fat material to be placed at the interface of fat or bone models. This design approach addresses three problems. To eliminate the air gap at the fat interface, the new phantom material must be a compressible solid, (rubber foam or soft epoxy) or a viscous liquid material. Secondly, the material must adhere to the current phantom tissue. Finally, the thermal properties (specific heat) of the two materials should be approximately equivalent.

The electromagnetic properties of the new synthetic fat tissue must be approximately equivalent to the currently used synthetic fat. At a minimum, materials for each of diathermy frequency bandwidths must be developed (i.e. 13.56 MHz, 27.12 MHz, 40.68 MHz, 915 MHz and 2450 MHz). Ideally materials should be developed which could be used for any frequency between 10 MHz and 3 GHz.

When materials with acceptable mechanical and electrical properties have been developed, the modified phantom model must be tested using a thermographic technique developed by Guy. Briefly this procedure involves the following steps. A high power source is connected to a diathermy applicator. The applicator is then used to irradiate the phantom model for a short period of time (10 to 20 sec.). An infrared camera scans the model, recording the heating distribution in the model. Comparisons of theoretical and measured Specific Absorption Rates (SAR's) for several diathermy applicators will be used to verify correct heating in the model. SAR is defined as the rate of energy absorption per unit mass. The peak SAR's in the model should not vary as a function of applicator orientation on the model (i.e. the direction of the electric field vector with respect to the model interface should not affect the SAR in the model). Also, thermograms of heating induced by applicators with irregular field configurations will be made to insure that "hot spotting" is eliminated from the model.

FINDINGS TO DATE: The majority of effort this year has been concentrated on developing phantom materials which simulate human fat tissue at 27.12 MHz. This was made a priority item because the Bureau of Radiologic Health is interested in promulgating a standard for shortwave diathermy equipment. These models would be used for determination of the amount of stray radiation during clinical treatments with shortwave. It is known that the synthetic fat material used at microwave frequencies has electromagnetic properties which are unacceptable for use at 27.12 MHz. Specifically, the dielectric constant and electrical conductivity of the synthetic material are lower than the values published by Schwan for human fat tissue. Acceptable values of dielectric constant and conductivity were achieved at the frequency of 27.12 MHz by empirically varying the ratios of materials currently used for synthetic fat tissue at microwave frequencies.

APPLICABILITY: The development of the new phantom material will allow us to develop and test new diathermy applicators that can heat specific areas that need treatment and will also be safe to patient and operator by having the least amount of stray radiation.

076 Quantification of Biomechanical Function of Ankle-Foot Orthoses in Hemiplegia

Principal Investigator: Justus Lehmann, M.D.
Status: New
Dates: December 1977-December 1979
Cost: Annual $17,029 RT Annual $11,764 Projected Total $34,000 RT % of Annual Total 69%
Annual Report Reference: #16, Page 160, R-136

OBJECTIVES: To evaluate the biomechanics of ankle-foot orthoses and their effect on the gait of persons with upper motor neuron paralysis and/or hemiplegia. The first phase of the evaluation will measure the moments and forces required to maintain the paralyzed foot and ankle in a functional position throughout the gait cycle. The second phase will determine the effect of these forces on knee stability throughout the gait cycle by measuring the moments developed around the knee. This will allow us to establish design parameters for ankle-foot orthoses and to relate these to the function provided by orthoses currently manufactured. With this information, a method may be developed to prescribe orthoses according to a discrete set of quantitative criteria.

METHODOLOGY: We will measure the ground reactive forces, the forces carried in the orthoses and the kinematics of the gait cycle. All of these variables will be measured through the entire gait cycle, i.e. from heel strike to heel strike. The ground forces will be measured by a force platform which is standard equipment in our laboratory. This system measures the orthogonal components of force applied to it, from which the location and magnitude of the force vector leaving the platform can be calculated. The forces in the orthoses will be determined using strain gauge transducers to measure the moments in the uprights throughout the gait cycle. The kinematic data will be measured by using a 35 mm motion picture camera to record the position of the limb in space, with markers identifying the axis of rotation of the knee and specific locations of the foot. These spatial data will be synchronized with measurements of the ground reactive forces and the moments in the orthoses. Kinematic data will also include stride length, cadence and phase of gait. Flexion angle of the knee is also recorded.

With the ground reactive force data and the kinematic data, the total moments in the leg and orthosis can be calculated. Then, by subtracting the moments measured in the orthoses from the total moments, the moments in the limb can be calculated. In addition, using the vector calculated from the ground reactive forces and the kinematic data describing the position of the knee axis, the flexion-extension moments at the knee can be calculated. Other measurements such as stride length, cadence and phase of gait are used as control variables.

The measurements described will be made on ten hemiplegic patients with varying degrees of spasticity. We will determine the ranges of force necessary to maintain the patient's foot in function positions during the stance and swing phase. We will then apply an orthosis which provides only the force defined in the measurement re-evaluate his gait for knee stability and specific kinematics.

FINDINGS TO DATE: Data have been collected on two hemiplegic patients. Several problelms were encountered in taking this data: the ranges and phasing of the forces were considerably different than in normals due to spasticity, and a general pathologic gain, i.e. inconsistencies in stride length, cadence and an inability to walk predictably. After several attempts, the proper scaling within the ranges of the transducers was achieved. The data show considerable difference between the pathological gait of a spastic hemiplegic and the gait of a normal subject who has had a flail ankle induced by the use of peripheral nerve blocks. Further observation will be necessary before complete conclusions can be drawn.

APPLICABILITY: The ability of the hemiplegic patient to walk can most significantly alter his ability to integrate into the community. This study aims at the development of a more sophisticated approach to bracing the patient. By quantification of the loss of function as well as the degree of function which is restored by various designs of orthoses, the needs of each hemiplegic patient can be met more selectively, and the danger of over or underbracing the patient will be lessened.

A large segment of the population would be affected, since the information would apply not only to the 2 million stroke victims but also to other patients with upper motor neuron lesions.

077 Evaluation of Long-Range Wheelchair Ambulation

Principal Investigator:	**C.G. Warren, M.P.A.**	
Status:	**New**	
Dates:	**September 1977-December 1978**	
Cost:	**Annual $12,341** **RT Annual $9,085**	**Projected Total $15,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#16, Page 184, R-137**	

OBJECTIVES: The objective of this study is to evaluate the use of a third wheel mechanism in long-range ambulation by paraplegic persons of various lesion levels and to compare its advantages over the conventional wheelchair, and to determine its limitations in negotiating inclines and in general maneuverability.

METHODOLOGY: A third wheel will be made available to this Center by the Werkenrode Institute of the Netherlands. Any adaptations to allow it to fit American wheelchairs can be made at the Center. It is anticipated that these modifications will be minimal. The evaluation will be conducted on 9 patients, 3 with lesion levels of T6 through T10, 3 from T10 through L3 and 3 with L3 and below. A set of pre-test criteria will be established to ensure that each of the subjects is capable of utilizing the third wheel mechanism.

The first evaluation will be a rate/distance comparison to the two chairs on a level 0.6 mile oval track for a maximum distance of two miles. Rates of ambulation will be controlled by a speed controlled cart at rates of 7, 9 and 12 kilometers per hour. The three trials will be performed in the conventional wheelchair and in the chair utilizing the third wheel. The maximum distance traveled will be recorded.

In the second phase of the study, sections of the Seattle bicycle pathway will be used to evaluate the effectiveness in ascending and descending inclines of 6%, 9% and 12% over a distance of 1000 meters. The velocity/distance evaluation will then be conducted in the two chairs at 4, 6, and 8 kilometers per hour, with distance recorded. The final evaluation will be an obstacle course. Performance will be timed through a standardized system of barriers including ramps, curbs, a slalom and a concentric circle drill to establish minimum turning radius. Evaluation of incline will be performed on wet and dry pavement and over moderately rough terrain to evaluate traction.

FINDINGS TO DATE: The sample of subjects has been identified and a preliminary evaluation is being conducted to determine their ability to operate a hand-cranked ergometer. To date all subjects but one have been able to function at 200, 300 and 400 Kg-M/min. for sustained periods. Heart rate is measured prior to exercise and in the recovery period. These heart rates will be correlated with those measured in the activities using the third wheel and in regular wheelchair ambulation. This is done to establish a rough estimate of metabolic demand.

Preliminary evaluations of the use of the third wheel in hill climbing show that for 300 yards at a grade of 4% the third wheel is more efficient than the wheelchair; that is, the distance can be covered in 34% less time with no difference in heart rate. The maximum incline on which this device is usable is still to be established.

APPLICABILITY: Increasing the ability of the disabled to perform long-range ambulation may be a significant factor in their ability to take advantage of community life, specifically on campuses and in local community activities. It is also important to consider the limitations this device might have. Once they are defined, it may be possible to engineer modifications necessary to overcome some of the limitations.

078 Development of a Portable Urine Flow Monitor

Principal Investigator:	**C. Gerald Warren, M.P.A.**	
Status:	**New**	
Dates:	**October 1977-June 1979**	
Cost:	**Annual $20,640** **[illegible] Annual $13,280**	**Projected Total $34,000** **RT % of Annual Total 64%**
Annual Report Reference:	**#16, Page 188, R-138**	

OBJECTIVES: The objective of this project is to design a portable self-contained mechanism using available technology for recording the volume and the time of voiding for the spinal cord injured person. The mechanism would be portable to the extent that it can be attached to a wheelchair and accompany the patient in his activities. It should be accurate to within 5 cc and be capable of registering time over a four hour period with an accuracy of ± 30 seconds.

METHODOLOGY: A mechanism would be developed to measure and record the time and volume of voiding with an accuracy of 5 cc volume and within 30 seconds in time. It would use a damped beam balance or calibrated spring to weigh the container into which urine flowed. Preferably, this container would be the disposable leg bag ordinarily used by the spinal cord injured person. The recording would be made by a modified mechanical clockwork used to drive a pressure-sensitive paper disc chart. A stylus connected to the measuring apparatus would form the link between the sensor and the chart. Design considerations would be: adequate mechanical dampening to avoid artifact due to impact of the mechanism; size, portability, ease of attachment to wheelchair, bed or frame; ease of cleaning and maintenance; and reliability.

The design of the mechanism would be carried out by engineering students at the advanced undergraduate level. A prototype mechanism would be developed and evaluated in the laboratory using flow calibration techniques to determine accuracy and reliability. Clinical trials will be used to determine functional problems. After necessary modification the mechanism would be packaged in a finalized prototype for clincial use, possibly incorporating it into a study of bladder management. The mechanism would also be submitted to industry for production as a clinical tool. Based on preliminary evaluations the mechanism might be produced for an amount reasonable enough to make it readily available for clinical use.

FINDINGS TO DATE: A system has been designed and several of the components necessary to assemble a prototype have been acquired. The key element of the recording system is a mechanical disc recorder driven by a clock mechanism. This element is small and spring wound and can be modified to perform recordings within the accuracy and reliability limits set. The transducing mechanism which is similar in design to a spring scale will effectively measure the weight of the urine as it is accumulated in either a leg bag or a night collection system. This design will be evaluated to determine the accuracy and reliability of indicated volume along with the damping necessary to overcome the inertial effects of activity such as wheelchair ambulation.

APPLICABILITY: The greatest threat to the health of the spinal cord injured person is renal infection and renal failure. This risk is directly related to the efficiency of the reflex of the voiding of the bladder. Considerable patient and staff time is spent determining when the patient has reached a functional bladder status. This apparatus would provide the information required without multiple schedule changes. It should therefore reduce involvement of personnel and allow patients to continue with activities which would otherwise be interrupted. In summary, it would reduce patient frustration, hospital time and expense.

079 Investigation of Predictors of Change or Treatment Progress in a Behaviorally-Based Treatment Program for Selected Cases of Chronic Pain

Principal Investigator:	**Wilbert E. Fordyce, Ph.D.**

University of Washington

Status: **New**

Dates: **July 1977-October 1979**

Cost: **Annual $27,048** **Projected Total $60,000**
RT Annual $9,775 **RT % of Annual Total 37%**

Annual Report Reference: **#16, Page 216, R-139**

OBJECTIVES: Among patients identified as having significant amounts of operant pain and selected for a behavioral-based treatment program:

to assess relationships among a series of measures of change in patient performance or activity level at the beginning and end of treatment and at selected followup points;

assess relationship between medical descriptive data, MMPI scores and pretreatment activity baseline measures, on the one hand, and amounts of change and durability of change through followup, on the other, in order to identify predictors of amounts of treatment gains;

assess changes between pre- and post-treatment estimates of health care utilization costs.

METHODOLOGY:

Subjects: The population studied will be persons with chronic pain problems who have been accepted for treatment in the operant pain treatment program on the Physical Medicine and Rehabilitation Service. These are persons 20-70 years of age who have a chronic pain problem of at least six months' duration which interferes significantly with their functional activity level. In adition, these patients have a significant component of operant pain; i.e., there is a learning component to the pain problem - as evaluated by a psychologist experienced in the evaluation of operant pain, as well as one or more physicians experienced in evaluating pain problems.

Materials: The Pain Data Protocol, Activity Diaries, physician evaluation data, and the Minnesota Multiphasic Personality Inventory (MMPI), and daily records of physical and occupational therapy activities will be used.

Procedure: Patients who are selected as potential participants in the Operant Program are brought into the hospital on the Physical Medicine and Rehabilitation Service. For 7-10 days there is a "baseline" period where baseline levels are taken for activity in physical and occupational therapy and, if necessary, there may be further evaluation of the pain problem. During this period patients will be given their usual medication on an "as needed" basis, with records kept of amount given and time pattern usage. At the end of the baseline period a treatment program will be drawn up, the program will be explained to the patient and his/her significant family member or friend, and, if accepted by the patient and friend, treatment will begin.

The inpatient treatment phase generally lasts 6-8 weeks, during which the patient participates in physical and occupational therapy activities which start out in small amounts and increase daily, vocational counseling and job station activities, programmed recreational activity, sessions with psychologists. Medication is put into "cocktail" form; i.e., put into a cherry syrup vehicle is given on time-contingent basis, and amount of medication in the vehicle is gradually reduced. Patients are positively reinforced for increased activity for recreation activities, for socialization. Pain complaints and nonverbal indications of pain are given neutral responses.

At the end of the inpatient phase, a one-to-two week outpatient program goes into effect. The patient initially maintains his/her inpatient schedule but lives outside the hospital and comes in daily. This is gradually generalized to include more away from the hospital activities.

Data during treatment will be collected as follows. Activity diaries will be completed by the patient daily and collected weekly throughout the inpatient and outpatient phases of the program. Physical and occupational therapy activities will be recorded at each session and records will be kept. An MMPI will be completed by the patient at discharge.

Follow-up data will be collected at three months, six months, one year and two years post-discharge. At three months', one-year and two-year follow-up, a week of activity diaries will be completed by the patient, and the follow-up section of the Pain Data Protocol will be administered to the patient (including data on health care utilization, income, activities). At those times, the Social/Leisure Form and a brief questionnaire recording vocational or employment status will also be completed.

Data Analysis: The continuous score variables can be assessed by correlational analysis.

Variables yeilding non-continuous data are likely to require non-parametric methods for analysis. The precise methods to be used will in turn be influenced by the size of the "n" and by sex distribution considerations. Statistical consultation will be drawn upon to assist in selecting the most appropriate methods for analysis of those data.

Such items as number of hospitalizations, number of surgeries, number of physician contacts, will require non-parametric item tally ocmparisons. Other measures such as days in hospital and dollars for medications, and dollar measures derived from estimates of costs of the various health care utilization activities can be analyzed by simple t tests, comparing pre- with post-treatment data.

FINDINGS TO DATE: A routine system for collecting and collating data has been set up, and a limited number of patients have completed treatment since the institution of the data protocol. Owing to construction and remodeling the number is somewhat less than anticipated, but is being caught up.

APPLICABILITY: Reference has been made to the Clowers survey showing that 13% of new DVR clients in the State-Federal program of Region X of DHEW are identified as having the disability of chronic low back pain. That figure alone establishes direct relevance to rehabilitation.

Patients treated in this program in the past have averaged 7 years since onset and 2.7 major surgeries for their referring pain problem (Fordyce et al. 1973). All patients treated have undergone multiple treatment programs prior to entering the operant program. Clearly, the more conventional treatment approaches have failed to solve the problem or the patient would not come for help. This means that a significant percentage of the labor force, and of vocational rehabilitation case rolls, include workers for whom treatment is failing to resolve their pain problems. The success of the behavioral approach and its rapidly expanding application throughout the country, support the inference that this project has direct relevance to rehabilitation.

080 Relationships Among a Set of Behavioral Measures of Chronic Pain

Principal Investigator:	**Wilbert E. Fordyce, Ph.D.**	
Status:	**New**	
Dates:	**July 1977-October 1979**	
Cost:	**Annual $22,598** **RT Annual $8,855**	**Projected Total $67,000** **RT % of Annual Total 39%**
Annual Report Reference:	**#16, Page 228, R-140**	

OBJECTIVES: To study the inter-correlations of a set of behaviorally-based measures by using a "comparable form" reliability assessment strategy. This objective can help to assess the utility of behavioral measures and to identify redundancies in measurement which can be eliminated.

To study the relationships between the behavioral measures and pertinent other information about the patients. This objective can help clarify the nature and extent of relationship between medical and behavioral measures and between personality test patterns and behavioral measures in the chronic pain patient.

METHODOLOGY: All subjects will be patients referred for evaluation of chronic pain problems. Each patient will be examined by one or more physicians, one of whom will complete the physician derived elements of the Pain Data Protocol. Data are obtained three ways: physician recording of examination findings and of his/her ratings on selected variables; patient-derived information obtained by a professional who interviews patient and spouse and either records patient verbal report or monitors the patient in completion of checklists, data obtained from two weeks of pre-examination patient recording of activity level of diary forms, and patient recording of MMPI responses.

Eventually some form of multivariate analysis is anticipated. But the present proposal is limited to inter-relationships; accordingly, the major statistical approaches used have been selected according to whether the measures under consideration are ordered into nominal scales, dichotomous variables, or more or less continuous data.

FINDINGS TO DATE: A total of 73 subjects have received all elements of the Pain Data Protocol. If the current rate of accretion of data continues, sufficient data should be in the computer to permit meaningful analysis by 7/79.

APPLICABILITY: There are not as yet available precise numbers indicating the rate or percentage of adults having chronic pain problems. The evidence seems clear that there are many and that they present a major burden in suffering, in health care utilization costs, and in expenditure of wage replacement funds. Moreover, the load is particularly high in the labor force, the population which is of particular interest in rehabilitation.

This project addresses itself to one of the basic problems in the management of chronic pain; namely that of identifying the score and extent of the problem and of how to assess treatment programs.

081 Quantification of Efficiency of Aphasic Speakers on an Oral Picture-Description Task

Principal Investigator: **David R. Beukelman, Ph.D.**
Status: **New**
Dates: **June 1977-June 1978**
Cost: **Annual $4,715** **Projected Total $4,715**
RT Annual $4,715 **RT % of Annual Total 100%**
Annual Report Reference: **#16, Page 308, R-143**

OBJECTIVES: To develop an objective, reliable and clinical useful method of quantifying language performance from language samples of aphasic speakers; to collect normative data, and to determine if the sampling and quantification procedures developed in this study are sensitive to severity of aphasia, course of recovery, and non-fluent/fluent classification.

METHODOLOGY: Subjects will be asked to describe the "cookie theft picture" from the Boston Diagnostic Aphasia Examination, which is commonly employed as a stimulus picture for evaluation of aphasic speakers. The analysis of the speech samples will include several measurements: 1. speaking rate (syllables per minute), 2. oral communication efficiency (different concepts produced per minute) and 3. oral communication efficiency incorrect grammatical structure per minute. Normative, severity and types of aphasia data will be collected and analyzed. In addition, the effects of recovery will be demonstrated over time.

FINDINGS TO DATE: Normative data was collected from 48 normal speakers. Data was collected from 45 aphasic speakers ranging from the 50th to the 99th percentile on the Porch Index of Communicative Ability. Five of the ten aphasic adults projected in the original proposal have been followed over 6 months of recovery.

APPLICABILITY: The documentation of improvement in communication function, the evaluation of high level aphasic persons, and the assessment of language function in running speech is closely related to the social, vocational and communication rehabilitation of persons with aphasia. The procedures examined in this study may improve our ability to asses the communicative skills of high level aphasic patients as the skills relate to vocational and social activities. These procedures may also permit the aphasic patient to be aware of his continuing progress as he reaches levels of performance to which the standard tests are insensitive.

082 Comparison of Methods to Reduce Shear and Displacement in the Use of a Reclining Wheelchair

Principal Investigator:	**C.G. Warren, M.P.A.**	
Status:	**New**	
Dates:	**June 1977-December 1978**	
Cost:	**Annual $5,175** **RT Annual $5,175**	**Projected Total $6,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 192, R-145**	

OBJECTIVES: The objectives of the study are to quantify the effects of the three proposed mechanisms: 1. relocating the axes of rotation of the wheelchair, 2. incorporation of a powered sliding seat or 3. using a sliding back mechanism. From this information, the optimum method of reducing the displacement between the person's body and the seating surface may be established.

METHODOLOGY: The most important factor to be measured as a criterion for effectiveness of chair modification was found to be displacement of the body relative to the seating surface. To be able to make this measurement more accurately, a powered reclining wheelchair with a powered sliding seat was modified to incorporate a low friction counterbalanced sliding back (Figure 1). The chair was then instrumented to measure the angular change of the back relative to the seat to record displacement of the sliding back, the sliding seat and any motion of the subject's lower trunk or leg segment. This was accomplished using precision rotary and linear potentiometers. The extent of the displacement will be processed by an extant data acquisition system and computer. Quadriplegic persons for whom a powered reclining wheelchair might be indicated will be selected as subjects for the study. They will be placed in the chair on a standard cushion and positioned until they are satisfied that they are comfortable and in a normal position for them. The chair will be reclined 5° from the horizontal and held in this position for 3 to 4 minutes, then elevated to the 80° position. The patient will be repositioned if he feels it necessary and the procedure repeated. This process will be repeated 7 to 10 times with each of the various conditions of the chair controlled (i.e. fixed or sliding seat, fixed or sliding back, or both fixed). The data will indicate which mechanisms produce the least displacement of the body with respect to the chair. It will also be used to determine through geometric calculations the center of rotation of the body and the effect that altering the axis of rotation of the wheelchair may have on further reducing displacement.

FINDINGS TO DATE: The mechanism to provide a low-friction, counterbalanced sliding back and to measure the displacement of sections of the chair and of the body were designed and fabricated as shown in Figure 1. The system was evaluated for valid accurate measurement of displacement and was determined to be reliable in making these measurements. Pilot runs have been completed using both normal and quadriplegic persons. The limited data we currently have on quadriplegic persons indicate that the greatest body displacement occurs with the fixed seat and fixed back, as was expected. This displacement is reduced when either the sliding seat or the sliding back is used, and the least displacement occurs with both the sliding seat and sliding back. Data have not yet been analyzed to determine the center of rotation of the wheelchair may have on further reducing displacement.

APPLICABILITY: This project has a distinct advantage in technology transfer, because it involves collaborating directly with the wheelchair industry to evaluate the optimum method to solve the problem. The findings, we believe, will be directly utilized by industry to produce a mechanism to resolve this problem for the severely paralyzed individual.

Determining which methods of eliminating shear and displacement for the severely paralyzed person would include quadriplegics, people with multiple sclerosis, post polio, congenital defects of the spine, etc. The improved reclining wheelchair may considerably modify the social and vocational rehabilitation goals of this category of patient.

083 Effects of Different Treatment Modalities on Range of Motion in Hemiplegic Patients

Principal Investigator:	**Sharon Greenberg, O.T.R.**	
Status:	**New**	
Dates:	**January 1978-June 1978**	
Cost:	**Annual $2,004** **RT Annual $2,004**	**Projected Total $2,004** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page 270, R-146**	

OBJECTIVES: To test the hypothesis that there will be a greater increase in active elbow extension in those hemiplegic subjects treated with kinesthetic biofeedback as compared to those treated with conventional occupational therapy, or those treated with a self-exercise (range of motion) program.

METHODOLOGY: Subjects will be matched according to age, sex, and general functional status; half will have a right hemiplegia and half will present a left hemiplegia. Using a random number table, subjects will be divided into treatment groups with equal numbers of right and left hemiplegic subjects in each group.

An initial and final assessment of range of motion and functional skills will be completed on each subject. Group I subjects will receive audio-visual kinesthetic feedback through an electrogoniometer strapped to the lateral aspect of the involved arm with the fulcrum at the elbow joint. A trip point will be set at the extreme of active elbow extension and a one inch green light will be activated when the subject is able to attain or surpass that range of motion. Group II subjects will be treated using conventional occupational therapy which has been determined polling eight occupational therapists in the greater Seattle area. Group III subjects will be taught a self range of motion program for elbow extension which they will carry out at home. The exercises will be revised as necessary at each session.

Each subject will serve as his own control in assessing the range of motion differences before and after treatment. The change between degrees of initial and final active elbow range of motion, scores on the Jebsen-Taylor hand function test, and the arc of function work space will be compared through analysis of variance between the three treatment groups and the sub-groups (right hemiplegics, left hemiplegics) within each treatment group.

FINDINGS TO DATE: Nine subjects have completed their treatment programs, three in conventional occupational therapy, four in kinesthetic biofeedback. All have expressed satisfaction with their therapy.

APPLICABILITY: Kinesthetic biofeedback may serve as an adjunct to present rehabilitation therapeutic practices by relieving disabilty, increasing functional use of involved extremities, and permitting efficient use of time, space and professional services.

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RT4

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Medical Rehabilitation Research and Training Center

CORE AREAS

The Comprehensive Rehabilitation of Persons with Severe Spinal Cord Injury

Describing and analyzing the mechanisms of the functional limitations and disability that are involved, devising new and more effective treatment procedures, evaluating systematically the outcomes of specific rehabilitation services, developing improved services that will enable persons with severe functional limitations to live productively in the community.

Rehabilitation of Patients with Ischemic Heart Disease

Evaluating the effects of reconditioning exercise for these persons and the physical and biochemical bases of these effects.

Behavioral Ecological Studies of the Comprehensive Rehabilitation Process

Assessing the patient's progress both inside and outside the hospital and the effectiveness of specific rehabilitation programs.

Rehabilitation-Related Applications of Biostereometric Methodology

Rehabilitation-related applications of biostereometric methodology to providing precise quantitation of the three-dimensional geometry of body deformities and limitations of motor functioning.

BAYLOR COLLEGE OF MEDICINE

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PROJECT TITLES BY FY 1978 STATUS

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Longitudinal Analysis of Patient Behavior (E. Willems, Ph.D)	084
Exercise and Lipid Profile in Ischemic Heart Disease (D. Cardus, M.D.)	085
Retention of Habituation of Reflex Activity Mediated by the Transected Human Spinal Cord (M.J. Fuhrer, Ph.D.)	086
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Development of an Optimal Discriminant Function for the Early Detection of Scoliosis (R.E. Herron, Ph.D.)	088
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Baylor College of Medicine

A Longitudinal Study of the Course of Vocational Development Following Severe Spinal Cord Injury (W. Alfred, M.A.) 099

PROPOSED

Evaluation of the Effects of Spinal Stimulation on Motor Performance in Patients with Upper Motor Neurone Lesions

Demonstration and Evaluation of a Model Surveilance System for Neurologically Active Drugs Used in Spinal Cord Injured Patients

084 Longitudinal Analysis of Patient Behavior

Principal Investigator:	**E. Willems, Ph.D.**	
Status:	**Completed**	
Dates:	**May 1973-September 1977**	
Cost:	**Annual $143,230** **RT Annual $133,201**	**Projected Total $281,765** **RT % of Annual Total 93%**
Annual Report Reference:	**#16, Page A-134, R-136**	

OBJECTIVES:

1. Completion of the basic, descriptive, longitudinal data base.
2. Continued development and routinization of logistical, analytical, and support procedures for the acquisition, coding, storage, retrieval, and displaying of longitudinal performance data.
3. Behavioral study of the natural history of treatment outcomes in spinal cord injured persons.
4. Development of techniques for measuring performance and adaptation after discharge.
5. Selection and development of clinically relevant indicators of patient performance.
6. Refinement and efficiency in procedures for gathering data.
7. Continued expansion of the conception and assessment of health status in terms of patient performance.
8. Continued practice at clinical use of LFA data.
9. Development of an approach to evaluating treatment programs in terms of their impact on patient performance.
10. Validation of other measures.
11. Packaging, dissemination, and development of procedures to train health care professionals to use and apply the LFA.
12. Preparation for clinical application and testing.

METHODOLOGY: The most important step toward achieving the objectives was the completion of our file of data. The gathering of the data was the context within which we developed procedures and tested reliability. The pool of data provided a growing set of illustrations and case studies for use in educational meetings and clinical activities. More importantly, the data pool provided the necessary longitudinal picture of the aftermath of spinal cord injury from which procedural refinements and best indicators of functional performance could be developed (see Project R-176).

During the project period, we obtained the following information:

1. Observational data from five days each week of hospital stay for 16 SCI patients (172 patient weeks in the hospital), including more than 29,000 instances of patient performance, classified by type, location, date, time, involvement by others versus unaided execution, and self-instigation versus other instigation.
2. Continuous instrumented data on time out of bed from the rest time monitor for 45 SCI patients.
3. Continuous data on wheelchair mobility from the odometer for 13 SCI patients.
4. Weekly subjective estimates by staff members of independence and mobility during the hospital stays of five patients.
5. After discharge, day-long records of activities, locations, and social involvements, obtained every ten days on ten discharged SCI patients. The periods of follow-up varied from three months to 30 months.
6. After discharge, wheelchair mobility data (odometer), obtained every ten days from three discharged SCI patients.
7. After discharge, assessments of the negotiability of the home environment, obtained every four weeks from nine discharged SCI patients.

This is the most extensive set of information ever assembled on the actual functional performance of SCI patients over time, and it provides (a) a description of the domain of performance after SCI and (b) a set of data from which the best indicators of patient status and progress can be selected.

FINDINGS TO DATE:

This section presents results in terms of the objectives discussed above.

1. Completion of the longitudinal data base. **Objective achieved.** The file includes partial data on 67 patients for various tests and procedural developments, as well as longitudinal data (in-hospital, post-hospital, or both) on 52 patients, enough to support the various analyses.
2. Continued development and routinization. **Objective achieved.** Procedural manuals and descriptions have been prepared for all of the major components of the system except one (coding of telephone interview data), which is being prepared.
3. Behavioral study of the natural history of treatment outcomes. **Objective partially achieved.** With a data pool as large as ours, this is the kind of activity that will inevitably continue for some time. For example: Common working opinion among rehabilitation professionals has it that a patient's degree of idle time is a sensitive indicator of progress; i.e., advanced patients are idle for smaller proportions of time. Contrary to that view, we find that the amount of idle time is not an indicator of progress and that idle time remains quite stable throughout the hospital stay. Changes in what patients do **during nonidle periods** are the important indicators of progress.
4. Development of techniques for measuring performance and adaptation after discharge. **Objective achieved.** In this crucial area of follow-up an monitoring of clients outside of the hospital, we have three techniques that are ready to use; i.e., they have off-the-shelf status. One is the wheelchair odometer (Alexander, 1977). The second technique is the telephone interview method for monitoring performance (Widmer, 1978a, 1978b). The odometer and the telephone method are inexpensive, simple to learn, and simple to use. The third procedure available is the negotiability survey (Norris-Baker, 1978a, 1978b).
5. Selection and development of clinically relevant indicators of patient performance. **Objective not achieved.** Although we have the data base and some strong hunches about best indicators, the selection of the indicators has not been completed under Project R-136.
6. Refinement and efficiency in procedures for gathering data. (a) Reliability. **Objective achieved** for all components of the work (Dreher, 1975; Crowley, 1976; Bailey, 1978; Widmer, 1978a, 1978b; Norris-Baker, 1978a, 1978b; Alexander, 1977; Stephens, 1978; Wiener, 1978). (b) Shorter techniques. **Objective achieved.** Information gathering procedures have been streamlined into usable form in all components of the work. When the issue of **which** information to gather is solved (Objective 5), the monitoring packages will be complete. (c) Substitute measures. **Objective partially achieved.** When the analyses of the overall data file are finished under Project R-176, we will have a definite picture of those dimensions of patient performance for which the out-of-bed measure and the odometer measure serve as indicators.
7. Continued expansion of the conception and assessment of health status in chronic disability. **Objective achieved.** Although we would always like to see more impact, the efforts at dissemination and utilization (see below), as well as the centrality of our work in Dr. Roberta Trieschmann's state-of-the-art evaluation, indicate significant progress.
8. Continued practice at clinical use of performance data. **Objective achieved.** We participated as full members of three clinical teams in charge of patients we studied. Several things have become clear from our involvement in clinical services. First, LFA data represent information that is not available from any other source. Second, LFA data provide staff members a coordinated and unified reference point for discussing the patient that often is nonobvious and which cannot readily be induced from the separate services. Third, Staff members appear very soon to become quite dependent on the presentation of LFA data, which indicates that they attach importance to these data. Fourth, staff members quickly come to appreciate objective, reliable, quantitative measures to replace their subjective, individual judgements. Finally, as a result of regular exposure to LFA data, we find clinical staff becoming more reflective and critical about their own observations of patients and the rehabilitation process.

9. Development of a general approach to evaluating treatment programs. **Objective achieved.** Findings from our work with observational monitoring, out-of-bed measures, odometer methods, and negotiability measures suggest that program impacts on client performance can be evaluated with great sensitivity, both at the individual and group levels.
10. Validation of other measures. **Objective not achieved.** We did some preliminary comparisons between LFA data and TIRR's Evaluation of Personal Independence (EPI) and weekly subjective staff estimates of patient progress. We have not had the resources to administer another major scale on a regular basis. Thus, this important objective will be shifted to Project R-176.
11. Packaging, dissemination, and training. **Objective achieved.** Training procedures are streamlined, procedural manuals are printed (except one, which will be finished soon), and parts of the system have already been applied in many other settings.
12. Preparation for clinical application and testing. **Objective largely achieved.** When the reduction and selection analyses are completed under R-176, this effort will be complete.

085 Exercise and Lipid Profile in Ischemic Heart Disease

Principal Investigator: **D. Cardus, M.D.**
Status: **Completed**
Dates: **May 1972-April 1978**
Cost: **Annual $118,633** **Projected Total $310,000**
RT Annual $115,633 **RT % of Annual Total 97%**
Annual Report Reference: **#16, Page A-195, R-139**

OBJECTIVES:

1. To obtain leads and trends regarding mechanisms by which physical exercise might have a protective effect on patients prone to or affected by ischemic heart disease;
2. To understand better the changes inducted by physical activity on the biochemical "millieu" in to help in designing programs of physical activity aimed at reconditioning people affected by "hypokinetic diseases" and rehabilitating patients who have had myocardial infarction.

METHODOLOGY:

1. Three groups of subjects are being studied: healthy men, men who have functional signs of ischemic heart disease (without myocardial infarction), and men who have already had myocardial infarction.
2. Each group will be subdivided into a subgroup with an exercise program and each subgroup will undergo periodic testing to assess working capacity and follow the changes in several biochemical parameters.
3. The overall plan of study involves the collection of clinical, physiological, and biochemical data.
4. Physiological measurements are based on the electrocardiogram, phonocardiogram, carotid pulse, and pulmonary ventilation of oxygen and carbon dioxide concentrations in expired gas. The biochemical studies consist of the determination of serum or plasma concentrations of plasma lipids, lipoproteins, glucose, uric acid, cortisol, and ACTH.
5. Statistical techniques will be used to ascertain if changes in the measured parameters show any relation to physical activity and ischemic heart disease.

FINDINGS TO DATE: Data collection for this project was terminated on April 31, 1977. A total of 1264 studies were made on 750 male subjects during the 56 months of data collection. A total of 220 persons were studied one or more times since the original evaluation. The distribution of subjects with the three clinical groups and according to their participation in a reconditioning exercise program is as follows:

	Healthy	**IHD w/o MI**	**IHD w/ MI**	**Total**
Exercise	78	22	44	14
No Exercise	35	19	22	[illegible]
Total	113	41	66	220

The data collected on these 220 patients inclusive of descriptive, anthropometric, blood lipids (with glucose and uric acid), maximal work capacity and parameters of the submaximal work are being entered into a computer data file. ACTH and cortisol determinations were made before and after the exercise test and following exercise training in a limited number of subjects.

A final report on the results of the analysis of the data obatined in this study is being prepared.

APPLICABILITY: Programs for the prevention of IHD and reconditioning of persons who have had a myocardial infarction have been for the most part ineffective. Adequate programs are needed for prevention, reconditioning and rehabilitation of persons prone to the disease. A better understanding of the disease is necessary before adequate programs can be designed. This study should give an insight of the changes induced by physical activity on the biochemical "milieu" of the body.

086 Retention of Habituation of Reflex Activity Mediated by the Transected Human Spinal Cord

Principal Investigator:	**M.J. Fuhrer, Ph.D.**	
Status:	**Completed**	
Dates:	**July 1975-December 1977**	
Cost:	**Annual $59,920** **RT Annual $10,933**	**Projected Total $134,000** **RT % of Annual Total 18%**
Annual Report Reference:	**#16, Page A-1, R-166**	

OBJECTIVES: After having developed a basic experiment paradigm for demonstrating retention of habituation of the flexor reflex in spinal man, additional studies were devoted to:

a. assessing the degree of retention as a function of the time since habituation training;
b. determining the effects on retention of continuing habituation training beyond the point that responsiveness is extinguished;
c. establishing whether retention is prolonged by widely spaced applications of the habituating stimulus during the retention interval; and
d. investigating whether more persistent retention is achieved by distributing habituation training over a normal of discrete periods.

METHODOLOGY: Each study involved a minimum of nine male patients with a functionally complete transection of the cervical spinal cord of more than 12 months duration. the raw and integrated EMG activity of the tibialis anterior muscle and of the rectus femoris was recorded unilaterally from the leg to be stimulated. Constant-current, electrocutaneous stimulation was applied through clip-on electrodes attached to the mid-plantar surface and to the dorsal aspect of the foot at the base of the fifth toe. Habituating stimulation was applied at the rate of 1/sec until all EMG responsiveness was extinguished. Following a stimulus-free retention interval that varied depending upon the particular study involved, the series of 1/sec stimulation was reinitiated and continued until extinction was obtained.

FINDINGS TO DATE: Differences in the degree of retention as a function of the duration of the retention interval depended importantly upon the measure of the retention that was analyzed. Generally speaking, however, the degree of retention was a monotonic, inverse function of the duration of the interval, with retention being much more marked after the 3-min. stimulus-free interval than the 21-min. interval.

No distinctive influences were attributable to continuing applications of the habituating stimulus after responsiveness was extinguished, regardless of whether retention was assessed in terms of the number of trials to extinction or indices reflecting the magnitude of EMG responses. Similarly, continuing repetitive stimulation after extinction had been achieved had no discernable effect on the extent of spontaneous recovery following the 3-min. stimulus-free interval that was maintained in each experimental session.

Application of the habituating stimulus at 30-sec. intervals during a 3-min. retention interval had a highly selective effect on the degree of spontaneous recovery and no effect whatsoever on the retention of habituation. These findings support the hypothesis that spontaneous recovery and the deg ree of retention may differently reflect the persistence of a prior history of stimulation.

A substantially greater total number of habituating stimulus was required with distributed habituation training than with massed training. It was not found, however, that distributed and massed habituation training had different effects on either retention of habituation or spontaneous recovery. These findings suggest that spontaneous recovery and retention of habituation are influenced not so much by the manner in which inhibition is developed during habituation training but rather by the degree of response strength present at the termination of habituation training.

APPLICABILITY: By using carefully programmed electrical stimulation of the skin or of peripheral nerves lying just under the skin, intrinsic neural control mechanisms can be brought into play which eventuate in reduced reflex activity. After the potentialities and limitations of this approach have been established, it will be possible to specify biomedical engineering requirements for developing practical methods of functional electrical stimulation to eliminate excessive reflex activity (including muscle spasms and exaggerated sweating) which interfere with the residual capabilities of these patients.

087 Analysis of Information Processing Training for the Severely Disabled

Principal Investigator:	**M. Sanderson, B.S.**	
Status:	**Completed**	
Dates:	**July 1975-May 1978**	
Cost:	**Annual $4,677** **RT Annual $4,677**	**Projected Total $38,400** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page A-265, R-170**	

OBJECTIVES:

1. To demonstrate the feasibility of placing suitably trained, severely disabled persons in the various fields of information processing including keypunching, communicating magnetic selectric typewriter, tape certification, key-to-tape entry and remote terminal data entry.
2. To develop effective procedures for selecting suitable, severely physically impaired trainees and to create effective training programs for them in the area of information processing.
3. To demonstrate the feasibility of obtaining subcontracts from business that produce revenue for the program and give trainees actual production experience before an attempt is made to place them in fulltime career position.
4. To explore the feasibility of developing a skills training program that will allow even the most severely physically limited individuals to obtain productive jobs in data processing.

METHODOLOGY: The procedures which will be followed can be divided into three sections.

1. Client training — severely disabled clients will be screened for appropriateness and those accepted will be trained on the CMC/ST, ATS, keypunch or tape certifier. The program is flexible in length, with an average training time of 3 months. Every effort will be made to obtain jobs for those completing training.
2. Business development — subcontracts will be obtained from Houston area businesses to give trainees experience on production oriented jobs before they are placed.
3. Computer program evaluation — programming training courses will be evaluated to determine feasibility for training the most severely disabled. Placement efforts will be made for all who finish such a course. Average training time: 6 to 8 months.

FINDINGS TO DATE: Of the sixteen clients served by PIP in the data entry training program, eleven were severely disabled. Six were confined to wheelchairs, two ambulated with crutches or a walker, one had severe arthritis in remission which affected both her gait and use of her hands, and two had emotional disabilities which had led to hospitalization on several occasions. Of these eleven clients, seven have been placed in jobs (one subsequently lost his due to personality programs), two were referred to in-depth evaluation programs at TIRR, one moved to another state, one changed to training in Micrographics and one dropped out for major surgery.

Being confined to a wheelchair did not hamper trainees in any of the major areas of training. The taper certifier was not modified to allow access by wheelchairs since its use as a training tool for large numbers of clients was not anticipated. The typewriters were mounted on adjustable tables which had room underneath for foot pedals and wheels. The keypunch machines were raised when necessary to allow access by wheelchair.

One of the primary characteristics that became increasingly important to the screening personnel before clients were chosen for training was the desire to work. The training itself was not found to be difficult for the trainees. Much of the trainee's time was spent in improving work habits and increasing motivation for holding a job. Very few clients were dropped from the program due to lack of skill or ability to improve. Most of the problems encountered had to do with poor ability to relate to people or desire to be independent.

One of the goals of the PIP Project was to determine which areas within the data processing field would prove the most profitable in terms of placing persons with disabilities. The area which seemed to have the most promise for trainees is keypunching. This is due to two factors: the skills are relatively simple to learn and the jobs are readily available. As with all areas which have been developed by PIP during the first two years, keypunch demands almost full use of hand and arm muscles. It is, therefore, not suitable for clients with upper extremity involvement.

Another goal of PIP was to determine if subcontract work could be generated to help offset program expenses so that it could continue without grant support and to provide a means of client's earning money while training. Subcontract work in general did not develop to the extent that was originally projected. There are several reasons for this. First, the program had just recently grown to a point where there would be enough production ready workers to be able to handle any sizable job. Second, because of the time constraints which usually surround keypunch jobs (overnight turn around), it was impossible to accept jobs as initial training tools. Clients need to have reached a certain rate of production before it is possible for them to execute a job within a short deadline. The most profitable area for trainees seems to be in text editing and manual preparation using the MC/ST. The turn around time on jobs is not as great in this area.

In support of the fourth objective, PIP joined with Goodwill, IBM and TRC to evaluate computer programming training. The major research activities during the 1976-77 year were directed towards this task. The principle investigator served as an advisor to and researcher for this joint effort.

APPLICABILITY: The successful realizations of stated PIP objectives will open the doors to new career opportunities for the severely handicapped. For those capable of working in competitive work situations the ability to earn income at levels above minimum wage will substantially decrease their dependence on government financial support and offer them opportunities for independence from families that might not have existed previously. The development of subcontract work will give individuals who are unable to work a full day or up to normal production rates the chance to contribute to their own support on a more limited scale. Subcontract work will also lessen the extent to which PIP requires federal grant funds for its continuation.

088 Development of an Optimal Discriminant Function for the Early Detection of Scoliosis

Principal Investigator:	**R.E. Herron, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1975-November 1978**	
Cost:	**Annual $43,482**	**Projected Total $131,000**

	RT Annual $22,701	**RT % of Annual Total 52%**
Annual Report Reference:	**#16, Page A-109, R-161**	

OBJECTIVES: This research will develop guidelines for designing a screening procedure by synthesizing from biostereometric data on scoliotic and normal patient populations a set of measurements which discriminate the two conditions. A potential future development from these measurements is a discriminant function for classifying individuals as normal or "potentially scoliotic" on the basis of body configuration.

The main objective of this research is to quantify the long-term changes in three-dimensional body geometry which accompany surgical treatment (Harrington rod procedure) of scoliosis. This represents a change in focus from our original objective which was prompted by staff changes and a growing clinical interest in non-invasive, stereometric documentation of the effects of surgical treatment on scoliosis.

METHODOLOGY: Data on whole body geometry of scoliotics will be derived from 25 sets of anterior and posterior stereograms chosen from among 50 such sets taken pre- and post-operatively of patients presenting for surgical correction of spinal curvatures at the Fondren Orthopedic Center. Normative data will come from stereograms of comparable normal subjects.

Established standards of posing will be employed to minimize changes in body configuration due to postural variations. These standards will be tested for their applicability to scoliosis and an effort will be made to identify additional poses which will more clearly reveal the effects on body geometry of a spinal curvature.

The whole body data for each individual at the pre- and post-operative (six months and three years) examinations will form the basis for analyzing the changes in body geometry over time. Evaluation of such parameters as bilateral symmetry of volume and surface area, horizontal rotation of trunk segments and location of center of gravity will reveal the nature and extent of changes.

FINDINGS TO DATE: The main activity during the present reporting period involved further data acquisition It was decided to postpone the analysis of the six months post-operative data until the three years post-operative data became available. This adjustment permitted us to devote attention to the more urgent matter of recording the body geometry of each subject when the subject returned for a three year post-operative orthopedic evaluation. The biostereometric records which have been obtained to data are summarized in the annual report. All the three year post-operative records were obtained during the present reporting period.

APPLICABILITY: The incidence of idiopathic scoliosis among adolescent females is estimated at slightly over one per cent (Baker and Zangger, 1970) with a rather lower incidence in young males. In the U.S., about 7,000 cases a year are treated with the Harrington rod procedure but the effects (of the procedure) on three-dimensional body geometry are not well documented. The present study will provide further information about the spatial changes in the form of the trunk at six months and three years after the operation. The new data should prove valuable to clinicians and researchers in their efforts to better understand and control the effects of surgical intervention in the treatment of scoliosis.

089 Immediate Stabilization of the Fractured Thoracic and Lumbar Spine With and Wtihout Neurologic Deficit

Principal Investigator:	**J.H. Dickson, M.D.**	
Status:	**Continuing**	
Dates:	**July 1975-November 1978**	
Cost:	**Annual $48,603** **RT Annual $47,477**	**Projected Total $131,000** **RT % of Annual Total 98%**
Annual Report Reference:	**#16, Page A-19, R-167**	

OBJECTIVES:

1. To document from an orthopedic standpoint the degree and durability of stabilization that is achieved by instrumentation applied shortly after fracture of the thoracic or lumbar spine.
2. To document how soon following surgery the patient can be made bed-free in order to participate fully in the rehabilitation process.
3. To describe the impact of the instrumentation procedure upon minimizing complications (urologic, integumental, etc.) which frequently accompany severe spinal injury.
4. To communicate the benefits of spinal instrumentation to orthopedic surgeons and neurosurgeons caring for patients with severe spinal injury.

METHODOLOGY: Records of patients having had fracture dislocation of thoracic and/or lumbar spine will be evaluated for:

1. Functional level at time of injury and at last follow-up.
2. Manual muscle testing performed at periodic intervals.
3. Time until patient is able to sit 6 hours a day.
4. Degree and type of fracture dislocation.
5. Amount of correction and stability developed by surgery and at follow-up.
6. Complications of surgery.

FINDINGS TO DATE: 151 patients' records have been evaluated. The average time until sitting six hours a day in a wheelchair has been three weeks from the time of injury in those patients operated on within one week of their injury. The initial evaluation showed that results were the same if the surgery was done within one week of injury. From a statistical view, however, many more cases are needed to analyze this completely. Reduction was almost anatomic in cases done within seven days of injury and remained so at the last follow-up.

New patients continue to be entered into the study and we are continuing to follow old patients. The results, in regards to reduction, stabilization, time to wheelchair and incidence of complication, in the new patients continue to show excellent reduction and stabilization. The old patients followed shows continued stability and reduction of the fracture site.

As we have gained confidence and have these evaluations, we are mobilizing our patients within 10 days from surgery. However, a limiting factor is the delay in referral of the patient to the rehabilitation center. In regards to return of neurologic function, comparing this series with those reported from England and Australia, shows that the amount of recovery is about the same. However, due to the difficulty and variability in recovery more patients are needed before we can say that immediate reduction and stabilization offers no better return of neurologic function than postural reduction.

APPLICABILITY: Systematic documentation of patient outcomes achieved by immediate stabilization of the unstable fractured spine will permit this approach to be compared with outcomes achieved by the non-surgical approach involving protracted bedrest. It is expected that the comparison will show that immediate stabilization permits the patient to much more rapidly and actively become engaged in the inpatient rehabilitation process, thus shortening its duration. As a result, the patient can proceed more quickly pursuing the educational or vocational aspects of rehabilitation. These outcomes have obvious implications for reducing the costs of rehabilitative care — as does the likelihood that immediate stabilization will eliminate the costly complications of extended bedrest including urologic, skin, metabolic, and peripheral vascular problems.

090 Appropriate Entry Level Jobs and Sheltered Workshop Tasks for the Less Educated, Severely Physically Handicapped With Upper Extremity Impairment

Principal Investigator:	**W. Alfred, M.A.**	
Status:	**Continuing**	
Dates:	**July 1975-June 1980**	
Cost:	**Annual $30,846** **RT Annual $30,846**	**Projected Total $129,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page A-232, R-168**	

Baylor College of Medicine

OBJECTIVES:

1. To document the details of successful entry level job experiences and sheltered workshop tasks that can be performed productively by severely physically disabled individuals who have upper extremity impairments and who have less than a four year college education.
2. To develop and evaluate two inventory formats containing the details described above for utilization by VR counselors and sheltered workshop personnel interested in providing improved services to the severely physically disabled.
3. To publish and disseminate the two inventory guides to VR counselors, sheltered workshop personnel, and rehabilitation practitioners involved in providing services to the severely physically disabled.

METHODOLOGY: In terms of the severely physically handicapped, the project includes the disability groups with which the RT-4 Center is identified, viz., spinal cord injury, neurological disease, brain injury, CVA, skeletal systems deformities, amputation, multiple sclerosis, muscular dystrophy, birth defects, chronic and severe arthritis.

From these disability groups, the project is limited to those (1) who manifest functional impairments in one or both upper extremities such as paralysis, spasticity, weakness, amputation, incoordination, deformity, and limited range of motion (2) who have less than a college education.

It is estimated that approximately 15-30 with the aforementioned disabilities and functional impairments will be entered into the program each year. The referral sources will include TIRR and the Texas Rehabilitation Commission.

To date, information on 37 clients has been registered.

1. Entry level jobs for this project are defined as jobs which require no specific vocational preparation beyond on-the-job training and/or less than six months of skills training. The criteria by which a severely handicapped person is judged as successfully and gainfully employed are: (a) receipt of minimum wages or above; (b) demonstrated ability to perform job assignments; (c) maintenance of employment for a minimum of 30 days.
2. For sheltered employment to be considered remunerative, the handicapped individual must demonstrate that he is capable of producing work at a rate of not less than the minimum floor wage that has been established by the U.S. Department of Labor for sheltered workshops; that is not less than 50% of the minimum labor wage. AT TIRR's WAP, the floor wage is $1.33 per hour. If a worker's productivity falls below this level, then he is considered as a slow and unproductive worker who cannot generate enough income to contribute to the financial solvency of the workshop operations and programs.
3. Before finalizing decisions as to what specific data to include in both reporting formats, other RT Center personnel, RT-4 Regional Advisory Council members, state VR administrative personnel and counselors, as well as sheltered workshop personnel will be consulted as to their views of the kinds of information that would be most useful.

FINDINGS TO DATE:

The final format resulted in a composite job inventory which contains:

1. a client profile which contains vocational relevant information and history about the disabled individual;
2. a job profile which presents basic factors about the job including identification information, employment requirements, job duties, and working conditions;
3. a client job profile which reveals an assessment of disability/job factors, work modifications, and client benefits.

The following sequential steps are being pursued:

1. Development of a preliminary model in consultation with local State VR counselors and administrative personnel, TIRR vocational and workshop staff, local workshop personnel and with the RT-4 Regional Advisory Council.
2. Evaluation of the proposed inventory with examples by a larger number of rehabilitation practitioners located in other RT centers, State VR agencies, sheltered workshops, and rehabilitation which serve the severely disabled. Their input will be obtained by means of an evaluation form.
3. Revision of inventory based on responses received from practitioners.
4. Publication and dissemination of inventory on a national basis.

5. Establishment of a clearing house to receive new data from contributors and dissemination of enlarged inventory at intervals.

The entry level job inventory has progressed to Step 2. The proposed model, which underwent nine significant revisions, was developed in consultation with the rehabilitation professionals outlined in Step 1. Recently the inventory format with examples was printed and distributed to 100 rehabilitation professionals for their evaluation by means of an evaluation form. These professionals represent individuals from 22 states who have expressed interest in the project. Currently responses to the evaluation form are being awaited prior to final revision of the format and publication of the inventory for dissemination on a national basis.

At TIRR Vocational Industrial Center, data on entry level jobs have been completed on 37 severely disabled clients.

The sheltered workshop task inventory will reach Step 2 by September, 1978. Current attempts are being made to simplify the data recording form. At the TIRR Vocational Industrial Center, data on six subcontracts comprising 22 workshop tasks have been acquired.

APPLICABILITY: The potential benefits of the project can lead to improved vocational services for the less educated and severely physically handicapped population with upper extremity impairments in a number of ways:

1. development of more appropriate vocational assessment techniques;
2. development of more adequate sheltered workshop programs to meet their needs;
3. improvement in vocational rehabilitation guidance and counseling services;
4. increase in number of job opportunities and placement possibilities for them;
5. reduction in their financial dependency on government sources;
6. greater increase in their social and economic independence.

091 Transitional Living: A Program Fostering Community Integration of Severely Physically Handicapped Persons

Principal Investigator:	**J.A. Cole, Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1976-December 1979**	
Cost:	**Annual $198,860** **RT Annual $32,795**	**Projected Total $719,000** **RT % of Annual Total 16%**
Annual Report Reference:	**#16, Page A-24, R-172**	

In June of 1976 TIRR began a model transitional living program called New Options which is designed to foster the integration of severely physically handicapped individuals into their communities. Goals of integration may include the establishment of independent living, involvement in educational and vocational opportunities, active social participation in the mainstream of society, the enhancement of personal skills important in daily problem solving, and the stabilization of goals and objectives required to maintain a satisfying quality of life.

Sub-study I: An Anthropological Study of Program Development

OBJECTIVES:

1. To trace internal processes of development in the transitional living program, focusing on changes in goals, methods of planning, program content, and in other areas.
2. To analyze the project as a social system, examining roles, interpersonal relationships, and patterns of interaction among staff members and participants.
3. To examine external relationships between the transitional living project and other organizations with particular emphasis on relationships with the host rehabilitation hospital and the state vocational rehabilitation agency.

Sub-study II: A Study of Program Effects and Outcomes

OBJECTIVES:

1. To determine the behavioral effects of the transitional program.

2. To determine the informational effects of the transitional program.
3. To determine the attitudinal effects of the transitional program.
4. To determine what specific effects the program will have on certain types of individuals and to develop a means of predicting relative outcomes.

METHODOLOGY: The anthropological study of program development utilizes observation, weekly calendars, logs and other routinely maintained records, participant diaries, and interviews with participants, staff, and personnel from outside organizations to document the evolution of the project and its operation as a service delivery system.

The longitudinal study of program effect and outcomes employs a series of measures which are made before, during, and after persons participate in the program to determine the effects of the independent variable (program) on individuals' behavior, attitudes, and information base. Data collection methods include intake and referral documents, wheelchair odometers and rest time monitors, functional activity and performance scales (Tufts Long Range Evaluation Summary), behavioral logs, informational quizzes, and questionnaires.

FINDINGS TO DATE: During New Option's second year of operation, the program evolved in several major areas:

1. refinement of service delivery methods (group training modules, practice experiences and field trips, modeling and individual counseling);
2. operation of the project as an organizational system;
3. determination of types of persons with various disabilities who can benefit from the program;
4. research development; and
5. preparation for production of audio-visual materials as a substantial program focus.

Information from the longitudinal study which has been processed to date includes demographic data on program participants, detailed information on program experiences, and outcome information which indicates that about half of the former participants are now living comparably more independently than they were before participation in New Options and about two-thirds are now in school or have part-time or full-time jobs.

APPLICABILITY: As a model service delivery system, New Options has demonstrated that community integration can become a feasible goal for many handicapped persons if they are taught and allowed to practice skills needed in the real world and if they are allowed to deal with stresses and assume responsibilities in a graduated transitional sequence.

In addition, many audio-visual training materials developed by the project will be appropriate for incorporation into both comprehensive rehabilitation and re-evaluation and follow-up programs at TIRR where patient education is a high priority and in similar rehabilitation facilities throughout the country. Many of the materials could also be used in day programs where a class or series of classes could be offered to handicapped populations through the sponsorship of various agencies. A workshop for DVR counselors also demonstrated the usefulness of New Options programming for counselor training on opportunities and resources for severely handicapped clients. It is expected that the demand for independent living skills training materials will increase substantially in the near future as rehabilitation legislation is enacted that mandates and funds independent living services.

092 Clinical Implications of the Disturbance in Calcium and Collagen Metabolism in Quadriplegia

Principal Investigator:	**J. Claus - Walker, Ph.D.**	
Status:	**Continuing**	
Dates:	**December 1976-February 1980**	
Cost:	**Annual $103,800**	**Projected Total $221,000**

Baylor College of Medicine

RT Annual $98,218 **RT % of Annual Total 95%**

Annual Report Reference: **#16, Page A-44, R-173**

OBJECTIVES: After onset of traumatic quadriplegia, the peak increase in calciuria is greater than in any other pathological condition and the hyper-hydroxyprolinuria may reach the same range as in Paget's disease. Part of the hydroxyproline is incorporated into large polypeptides, reflecting an excess in collagen synthesis (Krane et al., 1970). The simultaneous presence of these solutes may initiate crystallization in urine when the pH increases, and crystals may grow into calculi. The release of calcium and collagen from the bone leads also to local calcium and collagen fragments increases in bone extra-cellular spaces and lymphatic and venous effluents, where they may initiate ectopic calcification. The **first objective** of this project is to find (1) the bone and collagen related metabolic effects of extensive muscular disuse in man; (2) the additive effects of complete recumbency; and (3) how both effects are influenced by muscular exercises and by sitting. The **second objective** of this project is to find out if urinary tract calculi and/or ectopic bone are initiated while the patients have large increases in circulatory and urinary collagen metabolites and urinary calcium.

METHODOLOGY: **Description of subjects:** The 20 male patients included in this project will be Houston residents who have sustained functionally complete cervical cord injuries; 10 of these will have been injured less than a month and be entering the Texas Institute for Rehabilitation and Research for the first time, and 10 others will be returning to this hospital at least 2 years after onset of paralysis. **Record of progress and activity:** A procedure has been developed to document the patient's status every week during his hospitalization. The data will be used to establish scores for sitting and for muscular activity. **Urine collection and analysis:** Urine, collected on ice daily from the admission day to the discharge day, will be analyzed in pools of 7 days for the early patients and 2 and 3 days for the chronic ones. Calcium, hydroxproline, and non-dialyzable hydroxyproline will be evaluated. Hydroxylysine glycosides will be evaluated. **Urine extracts:** Urine extracts of 7 or 3 days urine pools will be prepared and stored "in vacuo." **Tetracycline marking:** During a period of high hydroxyproline excretion we will give the patient, after obtaining his written consent, 2 doses of 500 mg tetracycline for 2 consecutive days. In case the patient develops urinary calculi and/or ectopic bone, the specimens will be examined under ultra violet light to detect a flourescent line corresponding to calcification processes progressing at the time when tetracycline was administered. **"In vitro" experimental effects of urine extracts:** A synthetic urine-like solution has been prepared with variable calcium uric acid, and hydroxyproline concentrations. The solutions will be examined to detect the possible formation of crystals during 4 hours incubation at 37°C. The experiments will be repeated with the urine extracts. Traces of heparin were used in the "in vitro" crystallization experiment to assess whether or not this acid product modifies the precipitation kinetics. If crystallization is observed, the necessary conditions will be reproduced in the presence of 10 mg tetracycline. The crystals will be examined under fluorescent light and x-ray diffraction. **"In vivo" experimental effect of urine extract in rats.** Extracts will be made into the form of pellets containing 60 mg of extract. Urine extracts with low hydroxyprolinuria will be used for controls. Test pellets will be placed with a pellet injector near the right foreleg and hindleg, and the control pellets will be placed near the left legs of 20 rats. The animal will be palpated weekly to detect ectopic bone growth.

FINDINGS TO DATE: The total number of patients for whom urine collagen metabolites in conjunction with physical activity available is 36. The number of weekly urine pools analyzed is 196. The hydroxylysine glycosides were evaluated in 7 of these patients. The findings to date show that the initial trauma leads to increased bone turnover and to a general increase in collagen turnover. In patients injured over 3 years, the osteoporotic bone is very slow to lose more calcium during prolonged recumbency, whereas the increase in collagen turnover occurs more rapidly. The collagen lost originates from bone and from skin, this phenomenon being more obvious in patients paralyzed for several years. The "in vitro" studies are now completed except for tetracycline incorporation and the results for the x-ray diffraction. Each sediment weight has been compared at various pH. The results show that alkalinity is the predominant factor to produce heavy sediments with calcium crystals. The addition of heparin in the presence of increased uric acid produced **more** sediment in acid urine, but did not affect statistically the weight of the sediments in more alkaline urine. At similar pH, Proteus was more efficient than alkali to initiate a heavy precipitation. More descriptive results will be available after examination of the microphotographs and x-ray diffraction identification.

APPLICABILITY: The findings obtained in this project will be utilized to assess if improvement of bone and skin and shortening of the duration of the bone loss and their relapse all may be prevented by physical, and perhaps also pharmacological management. Such improvement will allow the patient to accede to professional rehabilitation at an early stage of paralysis, and to be able to maintain optimum functional capability, giving more independence and a better chance for continuous employment. This achievement will reduce hospital and rehabilitational costs and lower the occurrence of re-hospitalization and its additional cost. The data on heparin, together with the negative clinical data, does not suggest any relationship between a lesser incidence of urinary calculi in patients treated with heparin; this treatment is seldom given to TIRR patients. In addition to these results, we have examined the nondialyzable urine extracts of 3 early patients after dialysis, ultra filtration, and molecular sieving on Sephadex G-75. All of the hydroxyproline is present in the slowest of the 2 polypeptide fractions absorbing UV light at 230 millimicron, which is of small molecular weight. These polypeptides are described as being present in large quantity in collagen. The pattern is similar to the one seen in Paget's disease, except that there is more of the polypeptide. These results are currently being interpreted and will be published as soon as each fraction is hydrolyzed and identified by amino acid analyzer.

093 Application of a Neurophysiologic Profile to Predict Responses to Treatment of Abnormal Movements Associated With Severe Spinal Cord Injury

Principal Investigator:	**M. Dimitrijevic, M.D.**	
Status:	**Continuing**	
Dates:	**October 1977-October 1980**	
Cost:	**Annual $127,895** **RT Annual $72,044**	**Projected Total $302,000** **RT % of Annual Total 57%**
Annual Report Reference:	**#16, Page A-54, R-174**	

OBJECTIVES: The specific objectives of this investigation are to:

1. Perform comprehensive neurological and electrophysiological testing to develop objective criteria for classifying muscle groups of spinal cord injured patients in terms of being (a) under volitional control, (b) under volitional control when facilitated by such maneuvers as neck reflexes or vestibular reflexes, (c) activated only involuntarily by segmental reflexes or by indirect factors such as tonic vibratory reflexes, or (d) unresponsive.
2. For patients with selected muscle groups falling into one of the first three categories in item 1 above, develop operational procedures for selectively modifying the segmental reflex mechanism to achieve functional goals.
3. Assess possible correlation between types of control and other factors such as level of the lesion, kind of trauma, and clinical signs at different stages after the injury.

METHODOLOGY:

1. Population Sample - The study group will consist of approximately 50 patients from the Spinal Cord Injury Service of the Texas Institute for Rehabilitation and Research who experienced a traumatic injury of the cervical or thoracic region of the spinal cord at least eighteen months previously. This lengthy recovery period is believed desirable to provide a stable baseline of physical, physiological, psychological, and medical findings against which any changes in behavior resulting from specific interventions might be measured.

2. Instrumentation - The Neurophysiology Laboratory is arranged and equipped to support a large variety of measurement techniques and experimental procedures. The capability for essentially any electrophysiological technique required exists through the ability to measure electrical and mechanical events, record or store these signals, process them and display them, and to generate the necessary patterns of electrical and mechanical stimuli to elicit the desired response. These capabilities include wide band amplifiers and paper and magnetic tape recorders, general and special purpose digital computers and externally controllable isolated electrical stimulators as well as continuous and intermittent mechanical stimuli.

3. Neurophysiological Analysis of Residual Motor Control - Each patient in the study group will undergo a series of tests using electrophysiological techniques designed to determine the presence or absence of residual control of motor functions by the brain. The tone of selected muscles supplied by nerves arising above and below the lesion will be monitored by recording the response to controlled tendon taps. Similarly, the volitional and reflex control of these muscles will be detected by recording the electromyographic activity associated with volitional and reflex events. This neurophysiological investigation will provide evidence for an analytical differentiation of muscle activity which is produced by:
    a) volitional control
    b) volitional control requiring facilitation by such maneuvers as neck reflexes or vestibular reflexes
    c) involuntary or indirect factors such as tonic vibratory reflexes.

    Neurophysiological analysis of residual motor control will describe motor unit activity of selected muscle groups, the motor unit activation pattern, and evidence of concurrent and reciprocal muscle activity between antagonistic and synergistic muscle groups during attempts at volitional and postural reflex activation. Additionally, we shall examine the effects of volitional reinforcement on tendon jerk amplitudes by comparing averaged numerical values as well as determining the average amplitude variations during rest and during volitional reinforcement. Measurement of vibratory-induced tonic reflex in selected muscles such as the quadriceps femoris represents an independent parameter for the determination of segmental and suprasegmental functional and anatomical integration of the spinal cord.

    Each of the patients will be the subject of a program planning conference, involving representatives of the medical staff, the Clinical Neurophysiology Laboratory, and the physical therapy staff, to plan a specific program designed to gain maximum functional use of any residual motor control potential reflected in the neurophysiological profile. Following the initial conference to identify potential short-term and long-term goals for the patient, these potential goals and the possible means for achieving them will be discussed in detail with the patient and a significant member of the family. In some instances surgical or chemical procedures may be indicated to deafferent selected cutaneous zones and thereby reduce the intensity of spasticity as well as the sensitivity to gross muscle spasms.

    The physical therapy program will focus on teaching the patient specific techniques to trigger, augment or suppress motor activities below the level of the lesion which are of practical importance in improving the quality of life for the individual, such as triggering flexion and extension reflexes at appropriate times to assist in transferring from one position to another. Specific techniques may include the use of biofeedback and electrical stimulation of trigger points.

FINDINGS TO DATE: Specific methods for obtaining polyelectromyographic recordings to detect residual control of paralyzed skeletal muscles have been developed in our laboratory during the past two years and include the following:

The patient is supine and pairs of Beckman surface electrodes are placed over the quadriceps, adductors, hamstrings, tibialis anterior, and triceps surae of both legs. EEG signals from the occipital lobes are recorded to indicate the state of alertness and relaxation. Following a control period, maneuvers designed to elicit non-volitional spasms are carried out at least three times, such as, a deep breath, Jendrassik, neck flexion against manual resistance, eyes tightly closed, jaw tightly closed, grip dynamometer, etc.

The subject is asked to elicit any muscle spasm that he can and to demonstrate how the spasm is suppressed, as well. Voluntary activation of selected muscle groups is tested, such as bilateral hip flexion and unilateral knee extension, then the limbs are moved through specific ranges by the examiner to determine if passive movements elicit any motor responses. This is followed by an evaluation of reflexes, including bilateral tendon jerks, manual maneuvers to elicit clonus, tonic vibratory reflexes, withdrawal reflexes, tonic neck reflexes, and vestibular reflexes.

APPLICABILITY: The work undertaken in this project is directed toward minimizing the consequences of paralysis of limbs resulting from traumatic injuries to the spinal cord of man. Decisions about allocation of concentrated rehabilitation services should be based on neurophysiological documentation of the existence of preserved pathways. Only those who can potentially benefit should undergo the training program. In these selected candidates, special techniques will be devised to bring bothersome segmental reflexes under increased control so they can be used for transfer activities or maintaining equilibrium of the body. Preservation of nervous control rather than denervating spastic muscles will have the additional benefit of retaining the trophic function of nerves on the innervated muscles thereby helping to avoid the development of atrophy, edema, and phlebitis. Rehabilitation practitioners have long recognized the significant role of the control of posture in the prevention of trunk deformities and the importance of posture in patient adaptation to support vehicles. From our preliminary work, we anticipate that patient use of residual suprasegmental control of segmental organization in initiating or halting gross movements is possible and that it will significantly improve the quality of life for these patients.

094 Cardiac Rehabilitation Program for Patients With Myocardial Ischemia and Arterial Hypertension

Principal Investigator:	**D. Cardus, M.D.**	
Status:	**Continuing**	
Dates:	**September 1977-September 1980**	
Cost:	**Annual $145,278** **RT Annual $137,794**	**Projected Total $319,000** **RT % of Annual Total 95%**
Annual Report Reference:	**#16, Page A-225, R-179**	

OBJECTIVES:

1. To evaluate the effects of reconditioning exercise in patients who have both ischemic heart disease and hypertension.
2. To identify criteria which could be used to select coronary and hypertensive patients for exercise training therapy as a major component of a cardiac rehabilitation program.

METHODOLOGY:

1. Subjects - the subjects will be males 30-60 years old subdivided into patients having (a) hypertension (diastolic pressure above 90 mm Hg but below 130 mm Hg) without ischemic heart disease, (b) hypertension with ischemic heart disease (IHD) without previous myocardial infarction (MI) and (c) hypertension and having had a previous MI. Subjects in each group will be randomized into exercising and non-exercising sub-groups.
2. Procedures -
   a. Clinical classification. Hypertension will be determined by measurements of blood pressure at rest on three occasions. In case of doubt, an additional cold pressure test will be administered. The pressure of ischemic heart disease will be assessed by either documented myocardial infarction, a positive stress test or evidence of coronary stenosis by coronary arteriography.
   b. Pre-training evaluation. Each patient will be conducted an evaluation consisting of clinical and socioeconomic interviews, a physical exam, an exercise stress test and determination of some blood components. These determinations will eliminate those patients who have clinical conditions for which exercise is clearly contra-indicated or which might impair physical performance or interfere with the effects of an exercise program. The hypertension will be treated in an attempt to reduce it to normal limits prior to initiating an exercise program.

c. Exercise training. This phase will consist of supervised exercise with a bicycle ergometer conducted in our laboratory. Exercise will be prescribed according to individual performance and conducted five days per week for 20 to 30 minutes at each session. Each subject will be in the program for three months.

d. Follow-up evaluation. Physical performance evaluation will be carried out at the end of the exercise training period and at three month intervals thereafter. Evaluation criteria will be based on changes in the observations and measurements of the parameters of these studies and other indices derived from these parameters.

FINDINGS TO DATE: Current acitivities have been directed toward recruiting and testing individuals for classifying into the prescribed groups. A total of 101 persons have been tested since initiating this program. Over one third (36) of these persons were found to have hypertension. Seven of these hypertensive patients have ischemic heart disease and of these five have had a previous myocardial infarction. The patients with hypertension are being observed for medical management of their condition. This is done in an attempt to ensure a stabilization of the blood pressure within normal limits. Maintenance of normal pressure is desired so the patient may enter the phase of exercise training with the lowest possible mechanical load on the heart.

APPLICABILITY: The expected product of this research is the clarification of whether or not patients who have IHD and arterial hypertension can respond favorably to a rehabilitative program including control of hypertension and re-conditioning exercise. At present, these patients are generally excluded from cardiac rehabilitation programs. The results of this project may imply a change in this policy if adequate patient selection and combination of therapies are maintained.

095 Cervical Spine Injuries from Recreation and Sports

Principal Investigator:	**L.S. Kewalramani, M.D.**	
Status:	**New**	
Dates:	**September 1977-October 1980**	
Cost:	**Annual $32,873** **RT Annual $32,873**	**Projected Total $91,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#16, Page A-78, R-175**	

OBJECTIVES:

1. To document from an orthopedic standpoint, the mechanism of injury to the spine in patients following sports and recreation related activities - diving, collision sports and gymnastics;
2. To document from a neurological standpoint the patterns of deficit and recovery;
3. To utilize the orthopedic and neurological data to develop neuro-radiological criteria for classification of these injuries;
4. To compare neurological return, hospital course in these patients and cost of medical care of operated versus conservatively treated groups of patients;
5. To identify possible preventive measures in an attempt to reduce the incidence and severity of injury to the spine; and
6. To identify possible preventive measures directed towards minimizing the post trauma complications.

METHODOLOGY: Overview - The design of the data recording forms for this study will be complementary with the protocols being utilized by the RSA-sponsored National Spinal Cord Injury Data Research Center which is associated with RSA's Model Demonstration Projects for Spinal Cord Regional Systems. Thus, it will be possible to relate the detailed orthopedic, neurologic, and radiographic findings that will be generated in this study to the relatively much less refined data being collected on a national scale in the Center's study. A divident of this approach will be that the findings of this study will be potentially more amenable to generalization on a national scale.

It is intended that this investigation will be conducted in three phases: (1) retrospective analyses

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of the available data from two different spinal cord injury programs in this country; (2) the formulation, operationalization, and pilot testing of a prospectively oriented study to be conducted in the TIRR Regional Spinal Cord Center.

FINDINGS TO DATE: At the Texas Institute for Rehabilitation and Research, medical records of 134 patients were exhaustively reviewed. Available radiographs of all these patients were also carefully examined to analyze the mechanism of injury to the spine. 84 patients had sustained injury from diving; 40 were involved in collision sports and 10 were injured during gymnastics.

A record form has been developed to abstract pertinent information. This form will be used for Phase II (pilot testing). The data from TIRR medical records have been pooled with those from UCD Sacramento Medical Center. Forty-six patients sustained injury to their spine in collision sports. Forty were injured in football, 5 in wrestling and one in boxing. All 46 patients were males. Sixty-five patients were 16-20 years old. Seventy-eight percent of patients had a neurological picture of complete traumatic myelopathy, 9 percent had features of acute anterior cervical cord syndrome and the other 9 percent had features of acute central cervical cord syndrome. There were only two patients with paresthesias but no other objective neurological findings.

APPLICABILITY: Systematic analysis of the mechanism of injury, patterns of neurological deficit and recovery along with the comparison of the methods of treatment (operative versus non-operative) in each group of patients included in this study will help in:

1. predicting the outcome of treatment much more accurately;
2. choosing the appropriate method of treatment likely to cause minimum complications and expedite rehabilitation of patients admitted in a comprehensive rehabilitation program; and
3. developing possible methods to reduce the incident and severity of injury to the spine from recreation and sports. The protective equipment will be evaluated in the light of this new knowledge in an attempt to minimize the injury from collision sports.

096 Clinical Application of Longitudinal Functional Assessment

Principal Investigator:	**E. Willems, Ph.D.**	
Status:	**New**	
Dates:	**October 1977-October 1980**	
Cost:	**Annual $140,101** **RT Annual $126,525**	**Projected Total $383,000** **RT % of Annual Total 90%**
Annual Report Reference:	**#16, Page A-168, R-176**	

OBJECTIVES: Overall goals for the project period are to (a) finish the design of a refined LFA that can be used with many patients simultaneously; (b) begin extensive collaboration between clinical teams and the research team; (c) phase out involvement of the research team in the collecting and interpreting of performance data; (d) transplant the LFA to clinical teams in a number of other institutions involved in comprehensive rehabilitation; (e) package the manuals and training procedures; and (f) offer training workshops and internships for dissemination. Here are the specific objectives.

1. Clinical Application and Demonstration at TIRR
2. Application in Other Settings
3. Validation of Other Scales
4. Packaging, Dissemination, and Training
5. Advisory Group on Utilization
6. Evaluation of Acceptance and Impact
7. Accompanying Activities

METHODOLOGY:

Selection and Reduction - In earlier work, we have developed and pilot tested a logic and a series of quantitative steps to select the best longitudinal indicators of functional performance. The first phase, the minimizing and eliminating of redundancy, has now been applied to our entire data file.

The first step in this hierarchical process was to list the various measures by weeks from our files of inhospital data. This resulted in 215 separate measures for each of 162 patient weeks. Second, all of the variables were correlated with each other with an N of 162 (patient weeks). Third, the matrix of paired correlations was factor analyzed. This factor analysis was used to dimensionalize the variables and describe the network of variability, not to argue for some particular theoretical solution. Fourth, a geometric centers cluster analysis determined the clustering of the variables dimensionalized by the factor analyses.

Normative Data - Feedback from cinical personnel has told us that current information on the functional performance of an individual patient is most meaningful when presented against the backgrouond of standard or normative data from other patients. Our approach to standard curves establishes the number of time units (weeks) to be displayed by basing it on the average number of weeks of hospital stay for a previous sample of patients. Then, the areas under individual curves are distributed across the time units. Standard deviations indicate the band width of variability for each time unit. When a new patient's data are plotted on this normative curve each week, the clinical staff can see readily how the new patient compares to the longitudinal norm.

Other Settings - Extensive new applications of our work have occurred in three settings. Since these applications involve no direct cost to RT-4, they represent the kind of applications we want to promote.

Other Data - In order to evaluate the subjective assessments that staff members make regarding the progress of patients and in order to develop techniques to compare LFA data to other measures of performance, we asked members of the clinical staff to provide weekly estimates of patient performance (45 patient weeks). On Friday of each week, staff members from nine staff groups filled out forms on which they compared the patient to his previous week (same, better, worse) on **independence** (self-instigated and unaided performance), **diversity** (number of different kinds of performances), and **mobility** (extent of movement around the hospital).

Posthospital Data - We are almost finished evaluating the measures we use to gather follow-up data after dishcarge. First, we have completed the comparison of information yielded by the telephone interviews and the diaries provided by clients. Twenty-two subjects (disabled and nondisabled) each provided 20 days of data over a six-week period.

Second, we have begun our final procedural step to determine the validity or accuracy of the information yielded by the evening telephone interview.

Third, we have completed the analysis of surveys of negotiability conducted monthly in the homes of nine expatients.

Advisory Group on Utilization - From the beginning , our goal has been to present the advisory group with much more than a summary of past research and a list of questions. Rather, we want to present a set of specific proposals and hypotheses regarding the configuration and use of the final LFA, as well as a plan for testing and demonstrating it. However, those proposals have had to wait until we finish the analyses of our data files. Those analyses are almost finished and we are now at the point toward which we have been working for so long: a proposal for a concrete, usable, clinical measuring tool that is based on an unusually extensive and solid analysis of the domain to be measured. We are nearly ready to convene our advisory group.

FINDINGS TO DATE: **Selection and Reduction**

The factor analysis yielded 12 factors that accounted for 88% of the variance in the data set, and in which the first four accounted for 69%. The cluster analysis confirmed this basic structure of variables. The first and largest factor collected all of the performance dynamics, such as the various facets of self instigation vs. other instigation and unaided performance. Of the 27 positively loaded and 9 negatively loaded variables in this factor, the variable with the highest positive loading was the proportion of nonidle activities that the patients conducted without aid from others. In other words, this variable is a prime candidate for the status of a key indicator. Both the factor and cluster analyses confirmed that this variable is the key constituent of a very tight network of measures; i.e. for purposes of tracking patient progress, the other measures in the factor (or cluster) are redundant. This is the best indicator of the independence and performance dynamics of patients.

The second factor is related to mobility, environmental exposure, and environmental diversity. This factor collected the various facets of distance traveled (odometer), number of settings entered, and number of activities outside the ward. A key constituent of this factor (confirmed by the cluster analysis) is the number of feet traveled per day, as measured by the wheelchair odometer. In other words, the wheelchair odometer variable is a second key indicator.

Another major conclusion from our analyses is that idle time, time in bed, and indeed (with a few exceptions) activity in the ward are very weak indicators of patient progress. Furthermore, out-of-bed time and out-of-ward time are correlated highly. Stated another way, the strongest and most sensitive indicators of progress in functional performance are to be found during those times when the patient is active, out of bed, and out of the ward.

Here is the hypothesized LFA for the inhospital phase:

> The rest time monitor will be the signal system; i.e., will automatically signal the beginning and ending of a period out of bed. At the end of a period out of bed (patient back in bed), the performance monitor will contact the patient (either by telephone or face-to-face) and go through the listing of total activities and those conducted without aid during the period out of bed. This process will be repeated each time the patient leaves bed. In addition, an odometer on the patient's wheelchair will accumulate the record of distance traveled.

After the patient/client is discharged, the mode will shift to evening interviews by telephone every 15 days, surveys of residential negotiability every four weeks and continuous wheelchair odometer data.

APPLICABILITY: We anticipate two major sets of products from this project. The first set will include a tested and demonstrated method for the longitudinal measurement of functional performance by persons with severe physical disabilities, as well as the supporting manuals, descriptions, and procedures for training users. The second set will include a general approach to research and problem definition in the area of human behavior, specific methods of data gathering, a clear set of strategies for progressing from general description to refinement and testing of hypotheses, a large and integrated set of findings regarding the behavioral aftermath of spinal cord injury, and some new conclusions regarding the structure of human performance.

Rehabilitation is a teaching-learning process, and the essence of success in the process is the client's use of the newly learned skills and adaptations on a daily basis. The most accurate assessment of the degree of success is to document his actual behavior in everyday settings and over periods of time. And, his actual performance is the best basis on which to plan arrangements and programs.

Our perspective and our procedures have been somewhat new. However, they have been accepted by clinical staff and patients, probably because the principles of the LFA are seen to relate so directly to the central philosophical and pragmatic problems of rehabilitation: progress in functional performance and adjusting to the environment. We offer a conception of rehabilitation and a set of measurements around which patient programs can be unified and individualized. Our major purpose in this project is to test the extent to which this conception and the measurement procedures (the LFA) can be used by those responsible for delivering rehabilitative care to severely disabled persons.

097 Stereometric Analysis of Static Equilibrium in Patients with CNS Disorders

Principal Investigator:	**R.E. Herron, Ph.D.**	
Status:	**New**	
Dates:	**September 1977-September 1980**	
Cost:	**Annual $49,586** **RT Annual $36,981**	**Projected Total $131,000** **RT % of Annual Total 75%**
Annual Report Reference:	**#16, Page A-113, R-177**	

Baylor College of Medicine

OBJECTIVES: The main purpose of this preliminary study is to explore the use of a newly developed biostereometric sensor as a means of recording "static" body balance of patients undergoing therapy for disorders of the central nervous system.

The original biostereometric sensor was selected for an IR-100 Award as one of the one hundred most significant technical developments of 1974. With support from the Rehabilitation Engineering Center program at TIRR several refinements in the design have been made to make it more suitable for use in studies of the disabled. The proposed study represents a continuation of our efforts to further develop and demonstrate the clinical potential of this novel instrumentation system.

METHODOLOGY: The study will be conducted in three phases. Phase I will involve the development of a test procedure for evaluating the static body balance of a seated individual and when the individual is standing upright with the aid of parallel bars. Different methods will be explored with a view towards establishing the best means of sensor orientation and attachment for obtaining a faithful record of the individual's body excursions (at the point of sensor attachment).

When Phase I has been satisfactorily accomplished, the procedure will be applied to a small sample of patients (5-10) undergoing treatment for CNS disorders in the TIRR physical therapy program (Phase II). In the standing test position, the patient's lower extremities will be braced or splinted if necessary. During this phase, we will focus primarily on two elements: (a) eliminating any remaining practical difficulties in the use of the sensor by clinical personnel, and (b) identifying output parameters that will be most meaningful to the therapist and clinician.

Phase III will involve increasing the size of the subject sample in an effort to systematically establish standards against which to measure the patient's performance. Additionally in Phase III refinements in data output, both numeric and graphic, will be made to increase ease of interpretation by the therapist.

The biostereometric sensor has been used successfully to record the ranges of motion of major joints of normal children and adults. The concept of direct stereometric motion recording has proved to be basically sound and recent modifications to the original sensor design should make the aforementioned application to the disabled subjects quite feasible. The present project is an exploratory one, and it is impossible to prescribe a highly rigorous experimental program since the successive steps are dependent on not-readily-definable preceding ones. This limitation seems to be inherent to the development of a test procedure which departs substantially from the state-of-the-art.

FINDI[illegible] DATE: Research conducted during the current report period has produced results allowing [illegible]e completion of Phase I and the implementation of Phase II. In Phase I a test procedure was d[illegible]ped to measure the static equilibrium in both seated and standing subjects. It was found that the best method for location of the sensor arm was dire[illegible] over the C-7 spinous process. This arrangement allowed measurement of the maximum stability of a seated individual whose rotational elements are centered about the hips. [illegible]chment of the sensor arm at the C-7 process was used with the subject in a standing posi[illegible] represent the cumulative efforts of the trun and lower éxtremities to maintain postural st[illegible]ty.

Phase II was directed at accomplishing several goals. The [illegible] was to develop a means of obtaining a quantitative estimate of postural stability. The software capabilities developed during this stage allowed for production of: (1) numeric and graphic identification of the position of the subject's C-6 spinous process in space, (2) a measure of the total excursion distance recorded during a test trail, (3) the maximum area of horizontal displacement of the trunk while the patient attempted to maintain his balance and (4) histogram representation of the relative number of points recorded during the trial. Based on this output, the most important parameters in maintaining postural stability appeared to be: the length of excursion, the minimum area within which the excursion occurred and the duration of these features yielded at tentative Postural Stability Index (PSI) as illustrated in the following formula:

$$\text{Postural Stability Index} = \frac{\text{Duration of Trial}}{\text{Total Excursion Length} \times \text{Area}}$$

The larger the index, the greater the degree of motor control demonstrated. Further testing is planned to verify the validity of this index.

The second stage of Phase II focused on determining the clinical potential of the postural stability index. For this purpose we determined the PSI of eight subjects with serious disorders of the central nervous system -- the initial indices of these subjects ranged from .01 to .20.

Concurrently we are generating Postural Stability Indices on normal subjects yielding values for normals of 50. At present the patients used in this phase are being tested periodically in an attempt to record changes in postural stability that can be correlated to their progress in physical therapy. The aim of this process is to obtain an index which will indicate when changes in the therapy regime should be made.

APPLICABILITY: A sensor capable of providing a continuous readout of the position of a selected point on the surface of a body part, thus providing a three-dimensional spatio-temporal analysis of an individual's equilibrium control functions, affords great potential for evaluating the motor status of patients with upper motor neuron lesions and for documenting their progress in a therapeutic program. Such records provide new data concerning the effects of CNS disorders on critical motor functions and the remedial effects of different treatment regimens.

The production of a "hard copy" record of a patient's progress in gaining improved motor control of body balance may also prove valuable in motivating the patient to maintain a cooperative attitude towards the treatment procedures.

More complete records of equilibrium control functions at various stages of CNS disorders would contribute to a better understanding of the natural history of problems affecting the central nervous system. Information of this type could have important implications for both clinical and research purposes in rehabilitation medicine.

098 Stereometric Measurement of Thoracolumbar Mobility in Scoliosis With and Without Fusion

Principal Investigator:	**R.E. Herron**	
Status:	**New**	
Dates:	**September 1977-September 1980**	
Cost:	**Annual $51,377** **RT Annual $23,549**	**Projected Total $127,000** **RT % of Annual Total 46%**
Annual Report Reference:	**#16, Page A-121, R-178**	

OBJECTIVES: The purpose of the project is to explore the use of a stereomatic range of motion sensor (ROMS) for evaluating the natural history of scoliosis with and without modification by spinal fusion. The mobility measurement is confined to the thoracolumbar region because this segment is most affected by the fusion process.

METHODOLOGY: The population sample for this exploratory study will be comprised of five normals, five scoliotic cases with spinal fusion and five scoliotic cases without spinal fusion. All subjects will be within the age range 12-18 years and be matched as closely as possible with regard to sex and age. If the initial examinations present no special problems, the sample size will be increased as far as time and other practical constraints permit.

A stereometric Range of Motion Sensor (ROMS) consisting of a lightweight rod and a set of electro-optical transducers interfaced to a storage device, will be used to record point locations in three-dimensional coordinate form.

The spinal orientation of each subject will be recorded in five positions: (1) neutral; (2) maximum lateral bending to the left; (3) maximum lateral bending to the right; (4) maximum flexion and (5) maximum extension in the sagittal plane. The five tests will be performed according to the procedures outlined by the American Academy of Orthopedic Surgeons (1965). With the subject in position, the tip of the ROM sensor will be placed in contact with the spine at intervals along the entire spinal column. Control points will be recorded at the palpable limits of the spinal length at strategic landmarks, e.g. C1, T12 and S1. Additional points will be recorded between the control points, as close to identifiable vertebrae as possible. It is not essential that the intermediate points fall exactly on the vertebrae, because the ultimate aim is to characterize the orientation of the spine and its major segments as a whole. However, the feasibility of achieving close approximations of vertebral landmarks will be explored as part of this preliminary study.

Both graphical and numerical displays of the spinal orientation will be investigated in order to identify a simple and meaningful format suitable for clinical application.

The first phase of the project will be carried out during Year I. If the results are promising, the second phase will be devoted to a more tightly controlled experimental analysis, using larger subject samples, with a view towards obtaining a more representative statistically sound, data base. The ultimate aim is to generate functional standards which can be used routinely to evaluate the natural history of scoliosis and, perhaps, other spinal abnormalities.

FINDINGS TO DATE: Activities to date have centered on two major areas:

1. The development of a testing protocol for efficient data acquisition with a minimum of subject repositioning.
2. The development of suitable methods for comparing the spinal geometry and mobility in normal subjects and subjects with varying degrees of thoracolumbar curvatures.

The primary concern in the development of the testing procedure was to identify a means of positioning the subject so that the range of motion sensor (ROMS) could adequately digitize the location of the spine in the five desired postures without changing the relative position of the subject to the sensor. Of the five desired postural measurements four (a. neutral, b. lateral flexion right, c. lateral flexion left, and d. sagittal extension) presented no difficulties in obtaining data data sets. Use of the ROMS without hardware modification for the meaurement of sagittal flexion necessitated a change in the position of the subject with respect to the sensor. In an effort to eliminate this positional change a hardware modification to the sensor arm was made with the addition of an offset at the sensing end of the ROMS.

Following the development of the testing protocol a group of normal subjects were measured to establish a data set for the purpose of determining a means of generating graphic and numeric descriptions of the spinal geometry in the five desired postures. Preliminary evaluation of these data demonstrated that the spinal geometry could be represented graphically with little difficulty.

The means of developing suitable numerical quantification of the spinal geometry received the major emphasis in the current year's work. The desired outcome of this phase was to provide a numeric representation of the normal spinal curvatures that would serve as a value for the comparison of normal and abnormal curvatures. Because of the inter-individual variations noted in normal subject's spinal geometry it was felt that a polynomial definition of contour trends in these subjects be developed. The calculations and software were produced to obtain the polynomial necessary to generate a best fit trend. The final stage of this ongoing phase is to process the data collected for the normal group using these computational equations so that a numerical definition of the spinal geometry in each of the five positions can be provided and used for purposes of comparison.

APPLICABILITY: The improvement of methods for evaluating the natural history of severe disabilities is given a high rating (second order) in the recent documentation of RSA goals. It is our contention that the proposed method may offer a convenient, innocuous and comprehensive means of evaluating the effects of surgical intervention (fusion) on spinal mobility. It has the potential for making the evaluation of spinal mobility more objective, reliable and practicable than currently available methods. The apparatus is conceptually simple and a cost effective system based on modern electronic technology seems well within reach.

Baylor College of Medicine

099 A Longitudinal Study of the Course of Vocational Development Following Severe Spinal Cord Injury

Principal Investigator: W. Alfred, M.A.
Status: New
Dates: January 1978-January 1983
Cost: Annual $33,267 — Projected Total $165,000
RT Annual $30,728 — RT % of Annual Total 92%
Annual Report Reference: #16, Page A-278, R-180

OBJECTIVES: The basic purpose of this project is document the course of vocational development among SCI persons from the time shortly after onset of injury to two years post injury. Specific objectives are:

1. To determine what are the statistically documentable trends in vocational development among SCI persons during the prescribed period.
2. To assess how the vocational development of SCI individuals changes in its stability over time during the two years post injury.
3. To determine if trends in vocational development differ among groups of SCI persons according to differences in pre-injury level of vocational development, disability, kinds and degree of functional limitations, educational level, and age.
4. To determine if vocational outcomes among SCI individuals can be predicted in terms of vocational development observed during the two year course following injury.

METHODOLOGY:

1. Subjects - The subjects will be patients of the TIRR Regional Spinal Cord Center who have been admitted for comprehensive rehabilitation services no more than 90 days following injury. Each will have the provisional diagnosis of having sustained a spinal cord lesion (complete or incomplete) at a level ranging between C2, 3 to L5. The subjects' minimum age will be 18; their sex, race, and education will not be used as criteria for admission into the study.

   It is estimated that 35 to 45 subjects will be available for study over the entire two year period. Since some subjects will become unavailable for follow-up study, as many as possible (75-85) will be admitted initially into the project.

2. Interviews and Scales - Vocational Development will be measured using the Goldberg Scale of Vocational Development (GSVD). The pre and post injury sections of the GSVD will be administered to subjects during the interval between the time the patient is able to sustain vertical tolerance and prior to the medical prognosis conference. The post injury section of the GSVD will be repeated on a periodic basis at the following times:
   a. After the medical prognosis conference but before hospital discharge.
   b. During the first hospital readmission or first outpatient clinic visit occurring within a 2 to 6 month period after hospital discharge.
   c. During the subsequent hospital readmission or outpatient clinic visit occurring within an interval of 10 to 14 months.
   d. During a hospital readmission or outpatient clinic visit occurring at the end of 2 years post-injury.

   The Barthel Index, Manual Muscle Test, and Evaluation of Personal Independence Scale will be utilized to assess subject's functional abilities and to correlate with progress in vocational development. These scales will be administered during (a) and (b) as stated above.

3. Analysis of Data - The analysis of data will require:
   a. establishing reliability of trained raters in scoring the GSVD;
   b. correlational analysis to assess stability of the components of vocational development over time; and
   c. correlational analysis of the relationship of post-impairment vocational development with pre-impairment development, type and level of injury, age, degree of personal independence, and other demographic variables.

FINDINGS TO DATE: Satisfactory rater reliability in scoring the GSVD has been achieved. Ten SCI patients were admitted into the preparatory phase of the project which involved achieving rate reliability in scoring the GSVD. Since May 1, 1978, three SCI subjects have been admitted into the project for actual study. With two of the subjects the GSVD interviews have been administered prior to and after the medical prognosis conference. The third subject has had medical complications and has not yet achieved limited vertical tolerance.

As a result of an analysis of recent statistics on the SCI population at TIRR, a decision has been made to expand the study's admission criteria to (1) include patients admitted to TIRR within 90 days after onset of injury and (2) include patients with incomplete spinal cord lesions. This will allow for a broader based and more comprehensive study, particularly in analyzing the vocational development of persons with varying degrees of functional limitations as a result of spinal cord trauma and in comparing the vocational development process between those with complete and incomplete spinal cord lesion.

Since this modification of the study will require more accurate assessment of functional residuals among SCI patients, the Barthel Index scores will be supplemented by scores on the Manual Muscle Test (MMT) administered by the physical therapy staff, and by scores on the Evaluation of Personal Independence (EPI) administered by the occupational therapy staff. The MMT and EPI scores will be obtained twice: prior to first admission discharge and during the last hospitalization before the end of the 2 year post injury date.

APPLICABILITY: A key tenet of vocational rehabilitation practice is that the kinds of vocational services that are offered to clients must be finely tuned to the individual's readiness to participate actively in the rehabilitation process. In this study a serious attempt will be made to determine when vocational intervention should take place following SCI and, to determine the content of vocational services which would be most meaningful to SCI clients at different junctures in their post-injury vocational development.

Emory University (RT-6)
Medical Rehabilitation Research and Training Center

CORE AREAS OF RESEARCH DISSEMINATION/TRAINING

Medical

The etiology, natural history and the effects of various approaches to management of neuromuscular skeletal disorders.

Psychosocial

The effects of societal influences on neuromuscular skeletal disorders and the modification of these influences to reduce disability.

Vocational Rehabilitation

Those factors which influence vocational achievement and modify those factors to increase productivity.

EMORY UNIVERSITY

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PROJECT BY FY 1978 STATUS

COMPLETED

Clinical Field Trials of the Emory Detachable Electric Powered Drive for the Standard Wheelchair (B. Cohen, Ph.D.) 100

The Use of Motor Unit Potentials as a Measure of Neuromuscular Integrity (S.L. Wolf, Ph.D.) 101

CONTINUING

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Evaluation of Exercise after Myocardial Infarction National Exercise and Heart Disease Project (NEHDP) (C. Gilbert, M.D.) 103

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Training Improved Control of Spastic and Paretic Muscles with Computer-Controlled EMG Feedback (G. DeBacher, Ph.D.) 105

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Measurement Correlates in Chronic Low Back Pain: EMG Studies, Personality Profiles, Functional Performances, and Their Changes Following Sympathetic Blocks (S.F. Brena, M.D., S. Wolf, Ph.D.) 108

PROPOSED

Increasing the Utilization of the Feedback Finger Goniometers

Somatosensory Evoked Potentials in Cerebrovascular Accidents

Biofeedback Relaxation Therapy in the Treatment of Spasticity and Anxiety in CVA Patients

Biofeedback Rehabilitation of the Incomplete Spinal Cord Injury Patient

Developing Specific Treatment Strategies for Muscle Biofeedback in Stroke Patients

Emory University

Evaluation and Restoration of Function in the Hemiparetic Upper Extremity through EMG Feedback within Patterns of Movement

Increasing the Utilization of Feedback Finger Goniometers

The Development of a Systematic Approach to the Selection and Vocational Rehabilitation of the Severely Disabled

Biofeedback Relaxation Therapy in the Treatment of Spasticity and Anxiety in CVA Patients

OTHER FUNDS

Renal Rehabilitation Success Determination (R&D from RSA)

Expanding V.R. Services to the Cancer Disabled (Dept. of Human Resources, Division of Vocational Rehabilitation)

Renal Rehabilitation Success Determination (R&D from RSA)

Patient Education via Audio-Visuals (RSA Supplement)

100 Clinical Field Trials of the Emory Detachable Electric Powered Drive for the Standard Wheelchair

Principal Investigator:	**Bernard Cohen, Ph.D.**	
Status:	**Completed**	
Dates:	**August 1974-April 1977**	
Cost:	**Annual $9,979**	**Projected Total $30,000**
	RT Annual $5,850	**RT % of Annual Total 62%**
Annual Report Reference:	**#13, Page 214, R-54**	

OBJECTIVE: To measure the effectiveness of a detachable power unit for the standard wheelchair for patients with varying degrees of strength in the upper extremities and under a variety of conditions.

In developing a detachable motor drive for a standard wheelchair, numerous design criteria were considered. The objective of the last phase of this research was to make the current powered drive unit completely attachable/detachable solely by the wheelchair client. Additionally, the current unit was taken to another R&T Center for additional field testing.

METHODOLOGY:

1. Three detachable power units will be constructed during a three-month period.
2. During a ten-month period the units will be tested for five months locally and for five months in three other RT Centers. A report of the testing will then be written.
3. During the test periods, the effectiveness in terms of propulsion of the detachable power unit and the standard chair will be assessed by both rehabilitation personnel and by patient-clients. Three types of measures will be used: a questionnaire of personnel and client observations, actual test performances, and sampling use of the wheelchair by clients over a three-month period.

With the combined efforts of the Biomedical Engineering staff of the EURRR&TC and the Mechanical Engineering Department at Georgia Institute of Technology, a concentrated three-month (October-December, 1976) effort was placed on development of a user connectability mechanism for the existing drive unit. In keeping with this goal, and since the previous Principal Investigator has left our faculty, we have restaffed this project accordingly. This also accounts for some delay in progress in the past. In the two-month period January-February 1977, the completed drive units were taken to George Washington University, School of Medicine, Rehabilitation Engineering Center (Callif Mallik, Director) for additional field testing and evaluation.
Rehabilitation Engineering Center (Callif Mallik, Director) for additional field testing and evaluation.

Additional testing was done locally at the Georgia Institute of Technology Architectural Engineering Pedestrian Research Laboratory. This lab consists of numerous ramps and runways designed specifically for wheelchair testing. Use of their testing procedures enabled evaluation of the present drive unit in comparison with other commercial units.

FINDINGS TO DATE: Odometers attached to patient/client wheelchairs to determine miles traveled in their present chairs showed that a maximum of 13 miles per week with about 2.5 miles per work day. The Emory Detachable Unit has been found to do 10 miles on a single charge of the battery in initial testing. It also meets all criteria on climbing and descending inclines, turning radius, speed and ease of control.

Three phases were used to test efficiency and dependability of the Emory Unit. The initial phase consisted of trials within the Rehabilitation Research and Training Center (Morris, Gonnella & Cohen, 1976). A second phase consisted of field testing in various hospitals and health care facilities within the Atlanta area: The final phase of testing and evaluation of the Unit was to loan it out to selected clients who would use it in their daily lives, be it at work or in a home environment (Morris, Cohen & Gonnella, 1975).

Several hospitals affiliated with the Emory University School of Medicine were chosen to test the unit. This testing has provided us with much information which has been used in further refining and developing the Emory University Drive Unit.

Final testing within our Center was done with selected patients or clients who had the opportunity to try the Unit in their home environment or at their place of dailywork. Much of the information gathered in the clinical environment is of necessity anecdotal in nature. A questionnaire was given to the patient-users for their assessment of how well our design criteria met the patient's needs. The only design criterion which was not totally complete at the time of patient testing was the requirement that the unit be easily attached and detached by the user. This was not objectionable to the clients. Nevertheless, in a combined effort with the Mechanical Engineering Department of Georgia Institute of Technology, we completed work on this project and the current design is self attachable/detachable by the user.

After considerable in-house testing, it was deemed appropriate that a collaborative evaluation project be set up between this Center and the Center at George Washington University. This type of inter-center collaboration has the advantage of allowing objective, non-biased evaluation of a product or a device, while at the same time disseminating the existence of said products. As such, a fully operable Unit was transferred to the George Washington University, and a presentation made of its functional operation. After the presentation, a protocol was designed, and the unit was left at G.W. for further testing with a variety of clients.

APPLICABILITY: This unit will benefit a population of wheelchair users who could benefit from an easily detachable and attachable unit under their control that would convert a standard wheelchair into an electrical powered wheelchair. Advantages are: increased mobility because of the portability of the standard wheelchair; better use of a client's available energy; potentially less cost than the standard powered unit currently available.

Patient-client self-initiating power needs to be conserved and reserved for activities more self-sustaining than the act of transporting oneself. Wheeling oneself is a demanding task. The availability in cost and ease of the detachable power unit for the standard chair can significantly affect the patient-client mobility and ability to care for oneself, hold a job, enjoy life without a constant physical drain.

101 The Use of Motor Unit Potentials as a Measure of Neuromuscular Integrity

Principal Investigator:	**S.L. Wolf, Ph.D**	
Status:	**Completed**	
Dates:	**October 1975-September 1977**	
Cost:	**Annual -0-**	**Projected Total -0-**
	RT Annual -0-	**RT % of Annual Total 0%**
Annual Report Reference:	**#13, Page 219, R-55**	

OBJECTIVES:

1. Determine the motor unit distribution in an ulnar nerve innervated muscle (first dorsal interosseous) of the hand in normal subjects (quantifiable as the total number).
2. To make similar determinations in patients with disease processes of the central or peripheral nervous system (multiple sclerosis, muscular dystrophy, myasthenia gravis).
3. To evaluate the feasibility of motor unit determinations as a valid technique in assessing the neuromuscular status of patients.

METHODOLOGY: Electrical stimuli were delivered to the ulnar nerve at the wrist using a TECA chronaximeter constant current source. Stimuli were delivered once a second in trains of four, repeated five times. This evoked response was shown on a Digiview plasma display. Pulse durations were set at .5 milliseconds and the stimulus intensity was progressively increased to supra-maximal stimulation levels in order to recruit subsequent motor units. The computer program, designed by Mr. Harold Clifford, employed a PDP8/E computer. The computer program permitted a quantitative determination of the total motor units in the first dorsal interosseous muscle. An output voltage proportional to the displayed muscle signal was fed into the analog to digital converter of the computer. The oscilloscope sweep and the stimulator were triggered simultaneously by a clock generator. Data processing was performed on line. The real time clock was triggered after a determined delay by the pulse from the clock generator. Sampling time required was determined by the duration of the longest muscle potential. The computer was capable of storing in memory many potentials, each of which differed in the latency, amplitude, duration or wave form from its predecessor, and each was evoked by progressively increasing the stimulus to the nerve. These memory stores are referred to as templates. After many templates had been stored, a supra-maximal evoked muscle action potential was sampled and stored in the final template. The absolute area in each template was then derived. The number of motor units was calculated by the computer from the formula: $\frac{nA(max)}{A(n)}$ where n is a number of motor unit potentials in the penultimate template, A(max) is the absolute area of the supra-maximal evoked muscle potential, and A(n) is the absolute area of the potential composed of n units. Electrodes, appropriate for recording evoked muscle potential, were constructed based upon histochemically determined n plate locations (see below).

Originally, we had intended to gather data from normal individuals, and patients with a diagnosis of muscular dystrophy, myasthenia gravis, or multiple sclerosis. Due to the problems noted below, we felt that sampling of motor unit determinations in patients was not necessary.

FINDINGS TO DATE: The computer program allowed us to sample the voltage components of the motor unit potential at more precise time intervals than had previously been reported.

To improve electrode skin contact, several types of electrodes were used. The best electrode configuration involved use of either paint-on silver or silver plate electrodes which had been cut to conform to the first dorsal interosseous muscle contour. In both cases we discovered that changes in skin electrode impedance over time contributed greatly to changes given stimulus intensity delivered to the ulnar nerve at the elbow.

Based upon preliminary sampling, using normal subjects we must conclude that the quantification of motor unit or any of their characteristics can be greatly compromised by the failure of the investigator to rigidly check and note the adherence of the recording electrode to the skin surface at any phase of the recording experiment.

To minimize the occurrence of this problem, we then resorted to the use of paint-on skin electrodes. By using paint-on electrodes, we felt that any problem attributable to changes in skin electrode impedance might be minimized. We were disappointed to learn that the outcome of such attempts failed to greatly change the picture. Attempts to contact Drs. Ballantyne and Hansen in England to clarify our problems resulted in failure. Additionally, we contacted Dr. McComas at McMaster University in Hamilton, Ontario. He confirmed the reality of our problems and told us that in his attempts to determine motor units by recording all parameters (duration, peak to peak amplitude, surface area beneath the evoked potential) he met with similar technical problems.

One must conclude from these experiments in normal muscle, with the technical problems encountered in examining motor unit populations and responses to electrical stimulation of the appropriate nerve, considerable intra-subject variability can occur. As a result, one must question the efficacy and accuracy of the use of this technique as an electrophysiological diagnostic aid.

APPLICABILITY: In light of the difficulties encountered in executing this project, we believe that computer-based motor unit determination methods are unreliable as an adjunct to assisting the clinician in evaluating the neuromuscular status of patients.

102 Hormonal Agents in Myopathy . . . Metabolic Studies in Muscular Dystrophy

Principal Investigator:	**Daniel Rudman, M.D.**	
Status:	**Continuing**	
Dates:	**1971-Undetermined**	
Cost:	**Annual $5,600**	**Projected Total $5,000**
	RT Annual $600	**RT % of Annual Total 5%**
Annual Report Reference:	**#13, Page 17, R-14 & R-15**	

Emory University

OBJECTIVE : To develop a method to detect the premyopathic stage of myotonic muscular dystrophy.

METHODOLOGY: The metabolic balance study technique was used to quantify responsiveness to the anabolic action of human growth hormone.

FINDINGS TO DATE: A previous study showed 4 men with myotonic muscular dystrophy (MMD) retained 3 to 10 times more N, P, K, Na and Cl than normal men in responses to 0.168 unit human growth hormone (HGH)/kg (body weight) 3/4/day. The present investigation aimed to learn if the trait of hyperresponsiveness to GH could be used to determine the premyopathic state of the disease. Subjects were 3 MMD parents and 16 of their offspring ("B" and "W" kindreds). Each individual was evaluated for clinical muscle disease (atrophy, weakness, myotonia), 3 conventional premyopathic indicators of MMD (cataract, depressed immunoglobulin G, myotonic discharges in the electromyogram), and hyperresponsiveness to HGH. Among the B and W offspring, 3 had "clinical muscle disease" (atrophy, weakness, myotonia), 4 had no clinical muscle disease but exhibited one or more of the indicators of premyopathic MMD, and 9 had neither clinical nor premyopathic abnormality. To investigate a sex difference in hyperresponsiveness to HGH which became apparent in the B and W families, the study was extended to include 11 adults with clinical MMD from other families.

Hyperresponsiveness to HGH was exhibited by all 9 males (age 19-52) with clinical MMD, and by all 3 male B and W offspring (age 28-34) who did not have clinical disease but who did show presence of a premyopathic indicator. In addition, of 8 male offspring without clinical or premyopathic abnormality, 5 (age 18-24) were hyperresponsive to the hormone. Three postmenopausal females with clinical disease were hyperresponsive. Contrastingly, four females with clinical MMD and one with the premyopathic stage, all of whom had normal menstrual function, were unresponsive to HGH.

In 7 males with clinical MMD, all of whom were hyperresponsive to HGH, the administration of 4 ug ethinyl estradiol/kg (body weight) 3/4/day simultaneously with HGH suppressed the anabolic reaction to the latter hormone.

These observations indicate that in the male carrying the MMD gene, hyperresponsiveness to HGH develops by age 18 and precedes the appearance of cataracts, depressed immunoglobulins, electromyographic myotonic discharges, or clinical atrophy and weakness. In the myopathic or premyopathic MMD female with normal menstrual function, hyperresponsiveness to HGH is not present, but after the menopause this characteristic becomes detectable. The sex difference probably results from inhibition of the anabolic response to exogenous HGH by endogenous estradiol in the female heterozygote with normal ovarian function.

APPLICABILITY: Myotonic dystrophy is a disease which reduces the functional capacities of the patient. Early detection of the premyopathic or carrier state can facilitate rehabilitation planning and genetic counseling.

103 Evaluation of Exercise after Myocardial Infarction National Exercise and Heart Disease Project (NEHDP)

Principal Investigator:	**C. Gilbert, M.D.**	
Status:	**Continuing**	
Dates:	**June 1972-May 1979**	
Cost:	**Annual $112,000** **RT Annual -0-**	**Projected Total $877,474.66** **RT % of Annual Total 0%**
Annual Report Reference:	**#13, Page 84, R-42**	

OBJECTIVES: To Determine in Patients with CHD:

1. The effects of the exercise program on cardiovascular response measured by electrocardiographic responses, heart rate and blood pressure, physical work capacity, myocardial energy requirements and systolic time intervals (STI).
2. The effect of the exercise program on social and vocational psychological adaptation.
3. The operational problems of a long-term physical activity program.
4. The effect of the exercise program on mortality rate, recurrent MI, occurrence of complications of CHD such as angina pectoris, dysrhythmia and congestive heart failure (CHF).

5. The prognostic implication and value of resting and exercise ECG abnormalities in patients with MI.
6. These behavioral and psychological characteristics which are important to adherence and non-adherence in long-term physical activity program.
7. The effect of different personality traits and social characteristics on psychosocial adjustment to an MI.
8. The effect on the level of plasma cholesterol and triglycerides.

METHODOLOGY:

1. Participants tested semiannually.
2. Each participant completes an informed consent, a cardiovascular history, physical exam, before each multistage exercise test (MSET).
3. MSET is graduated progressively, designed to indicate roughly the 0_2 consumption of the patient at work and at rest.
4. Each stage is recorded as a 12 lead ECG with the XYZ scallar leads during the last 40 seconds of each stage.
5. MSETS begin with supine rest, STIS, and standing rest; exercises stages are completed with STIS and two supine recordings.
6. Written psychosocial measures to assess anxiety and depression levels are administered at various intervals.
7. Cholesterol and triglyceride levels are measured and analyzed annually.

FINDINGS TO DATE: As this study is a long-term and ongoing study, there has been no complete compilation of data by the Coordinating Center in Washington. At the conclusion of the project in 1980 a conference/symposium will be held to compile data results and decide on a dissemination plan for that data.

As of February 1, 1977, the Emory University Collaborating Center of the NEHDP had randomized 150 patients. The five collaborating centers of NEHDP have a total of 649 patients under study.

APPLICABILITY: If the basic objectives of the NEHDP are proven positive in the rehabilitation of MI victims the project could be of great benefit if introduced into the Vocational Rehabilitation Program of all states. Last year alone in the United States 29,270,000 Americans were stricken with some form of heart or blood vessel disease. Cooperation with the State Division of Vocational Rehabilitation in identifying potential clients for a program modeled after the NEHDP will be very important in returning patients to their prior productivity and useful place in the community.

104 Cognitive Assist in Motor Learning

Principal Investigator:	**Carmella Gonnella, Ph.D.**	
Status:	**Continuing**	
Dates:	**1973**-September 1978**	
Cost:	**Annual $16,907**	**Projected Total $30,000**
	RT Annual $16,907	**RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 87, R-45**	

***University Research Committee Grant - $981.20 **Activity on this project was discontinuous.**

OBJECTIVES:

1. Identify variables critical to the learning of a motor activity as it must be **learned by the patient;**
2. To assess the influence of these variables upon performance in the learning of a motor activity; and
3. To determine the effectiveness and feasibility of audiovisual self instruction in the primarily cognitive learning phase of a motor skill.

METHODOLOGY:

1. The rehabilitation skill to be learned is the three points crutch gait with one extremity non-weight bearing. The cognitive aspects of the skill are presented through a subject controlled audiovisual film simulation matched to the subject's sex and involved extremity. The testing of the effective-

ness of the learning phase is through the performance of the skill without further instruction.

2. Performance in the motor task will be measured by: (1) cognitive recall of the components of the skill as presented audiovisually; (2) spatial temporal analysis of a subject's filmed crutch gait sequence; (3) clinical rating of the subject's crutch gait performance.
3. **Design;** Since the question was delimited to the effectiveness, if any, of this teaching-learning strategy, a post-test control group only design was used. Subjects (N = 20) were working women, volunteers ranging in age from 36 to 60 ($\bar{x}$ 49.65, SD 7.36). One-half of the group was randomly assigned to take the cognitive test after viewing the film but **before** walking with crutches; they are identified hereafter as Cognitive Pre Gait. The other half took the test also after the film and **after** walking with crutches and they are labeled Cognitive Post Gait. The group difference in age (Cognitive Pre Gait $\bar{x}$ = 48.20; S = 8.52) (Cognitive Post Gait $\bar{x}$ = 51.10; S = 5.69) was not statistically significant.
4. Measures include: Subject's perception of motor ability, cognitive recall of task elements, and actual motor performance.
5. Subject's reaction to film presentation was also elicited.
6. Above method now being replicated (Study 2)to compare, in addition, ability to do task without any instruction/with instruction.

FINDINGS TO DATE: **Group Characteristics:** Although the two groups, Cognitive Pre Gait and Cognitive Post Gait did not differ significantly in age, they did differ along other dimensions. In comparison with the Cognitive Post Gait groups, the Cognitive Pre Gait group were more active currently with half of them having been even more active within the past three years; and they also perceived themselves as motorially more capable ranging from average to excellent. In the latter, the Cognitive Post Gait group showed a "normal" distribution from above average to fair.

Performance in Cognitive Recall: All subjects but one answered the questions correctly. The last subject of the day missed of the questions. Otherwise, the groups learned equally well from the film.

Subjects were asked also about the clarity of the film and the sufficiency of information after they attempted walking with crutches. All responded favorably. Filmed performance not yet analyzed.

Our subjective impression is that at least 75% of the participants performed adequately. When difficulties were encountered, persons were either obese (≥ 165 lbs.) and could not lift their body weight, or persons had expressed doubts about their ability and in fact also appeared to do less well than the others. Data from Study 2 now being analyzed.

APPLICABILITY: A teaching learning model of a rehabilitation task under patient control will be available which can accelerate patient rehabilitation, saving costs to the patient and time for both patient and health practitioners. The results will also make available an alternative mode of patient teaching learning as an illustrative example in the allied health curricula and to current practitioners.

105 Training Improved Control of Spastic and Paretic Muscles with Computer-Controlled EMG Feedback

Principal Investigator:	**Gary DeBacher, Ph.D.**	
Co-Investigator:	**Jim Malone, M.S.**	
Status:	**Continuing**	
Dates:	**August 1974-July 1979**	
Cost:	**Annual $30,861**	**Projected Total $210,781**
	RT Annual $25,909	**RT % of Annual Total 80%**
Annual Report Reference:	**#13, Page 98, R-52**	

OBJECTIVES:

1. To document in detail the EMG changes which occur during EMG feedback training to correct

spasticity and paresis.

2. From such detail, to learn more about the nature of the learning process, especially the extent of generalization from trained to untrained muscles, the strategies patients use to inhibit spasticity, and generalization of control from one limb position to another.
3. To use this information to make decisions about how to improve application of EMG feedback in clinical settings.

METHODOLOGY: The project is based technologically on an on-line computer which controls training and data acquisition, and conceptually on a training task hierarchy. Subjects are first trained to relax spastic muscles in the resting state, if necessary. Then more challenging tasks are introduced, including passive stretching of the muscle being trained, or voluntary contraction of its antagonist. EMG from up to four muscles is integrated every 1/10 second, digitized, and stored on disc memory for analysis. The computer generates auditory and visual EMG feedback displays and updates performance criteria based on the subject's progress in relaxation and control.

FINDINGS TO DATE: Five subjects with spasticity and paresis have been trained on a variety of tasks. Four received training to inhibit spasticity in elbow or wrist flexors during passive stretch at gradually increasing rates. Results for two were equivocal and not clearly indicative of learning. Two others learned to completely inhibit spasticity in the spastic elbow flexor from which feedback was derived, but showed incomplete generalization to the untrained spastic elbow flexors. This may imply that spastic synergists should be trained in groups rather than individually during clinical application of EMG feedback.

Two subjects were trained to better activate and control a paretic extensor muscle while inhibiting co-contraction of spastic antagonists. One succeeded remarkably and showed obvious improvements in extensor strength and muscle mass. The other subject did less well with wrist extensors and flexors, possibly because of flaws in the training paradigm.

APPLICABILITY: EMG feedback training is a new modality which is particularly useful with paretic and spastic muscles which are unresponsive to conventional neuromuscular re-education procedures. By itself, it is only a muscle training procedure, but training better control of individual muscles is sometimes an important pre-requisite to successful application of movement training procedures which produce functional gains.

106 Vasomotor Response Training in the Arthritic Patient

Principal Investigator:	**J. Malone, M.S.**	
Status:	**Continuing**	
Dates:	**February 1976-February 1979**	
Cost:	**Annual $11,807** **RT Annual $11,807**	**Projected Total $39,080** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 108, R-58**	

OBJECTIVES: To determine the applicability and the effectiveness of peripheral blood flow training in reducing the severity of arthritis symptoms.

a. To measure the degree to which arthritic patients can learn conscious control of peripheral blood flow.
b. To measure the degree to which patients experience reduced arthritic symptoms.

METHODOLOGY:

1. The training technique was applied to 9 non-arthritic subjects to test the equipment and prototype.
2. Five pilot arthritic patients were trained and arthritis activity measurements taken over a six month period.

3. A controlled study is beginning in which half the patients will receive true feedback training and half will receive false training. Arthritis activity measurements will be taken over a six month period. The degree of symptom improvement will be compared between the two groups.

FINDINGS TO DATE:

1. Five of the non-arthritic subjects received true feedback training and did learn to conciously produce changes in peripheral blood flow. Four received false training (as we plan to present to the control arthritic patients), and they did not exhibit the ability to control blood flow.
2. The five pilot arthritic patients all received true training.
    a. Three exhibited good ability to control blood flow and were cooperative. Their arthritis symptoms generally improved over the six month observation period.
    b. One Patient probably had control over peripheral blood flow but was uncooperative and did not return for the six month recheck of blood flow control. There was mixed improvement of this patient's symptoms until the last mesurement session during which it was observed that she had developed a reaction to her medication.
    c. One patient did not exhibit the ability to control blood flow. She developed a reaction to her medication rather early in the study, and as a result, the medication was altered substantially. Her arthritis symptoms generally worsened over the period of observation.

We are encouraged by the results from the three patients who were cooperative and whose medication was constant or varied only slightly over the observation period. In the next phase of this study half the patients will receive true training and half will receive false training.

APPLICABILITY: The daily activity of millions of arthritic patients in limited by the use of cumbersome treatment equipment and techniques (e.g. paraffin baths, heating pads, Hubbard tanks, and the use of massage). These techniques are difficult to apply outside of home or hospital. We are evaluating the effect on arthritis symptoms of a less restrictive therapeutic technique, the use of which would increase the patient's mobility, independence and employability.

107 Quantitative Assessment of Postural Stability and Steadiness in Stroke Patients and Control Subjects

Principal Investigator:	**Bernard A. Cohen, Ph.D.**	
Status:	**Continuing**	
Dates:	**February 1976-February 1980**	
Cost:	**Annual $22,900** **RT Annual $22,900**	**Projected Total $85,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 24, R-59**	

OBJECTIVES: The first objective of this research is to refine a technique for the quantitative assessement of postural steadiness and stability. This will be done using normal subjects to establish normative data for various age groups (Sheldon, 1963). The second objective is to obtain these same force platform measurements on stroke patients beginning as soon after their hospitalization as possible and continuing through the hospital rehabilitation period at weekly intervals. Changes in these measurements will be correlated with results from clinical diagnostic tests (EEG, angiography, brain scanning, etc.) to evaluate the efficacy of various medical therapeutic procedures. The third objective is to quantify the patient's rehabilitation therapy progress utilizing methods similar to those expounded by Simons (1970) and relate the changes found with those quantified measures mentioned above. The fourth and final objective is to utilize the accuracy and sensitivity inherent in a research tool (i.e., the force platform) to evolve a new as well as less expensive and more portable clinical equivalent tool or technique which will enable widespread utilization of the results from this study.

METHODOLOGY: A force platform is being used to measure the magnitude of the total vertical supportive force and the excursion of the center of pressure of this force in the fore-aft and medio-lateral directions. The movement of the center of pressure varies according to the movement of the center of gravity and the distribution of muscle forces required to control or produce movement.

Control subjects are selected from among volunteers. They are screened to present physical characteristics closely allied to that of the stroke patient population except for the required absence of any known neurologic deficits or gait anomaly, Patients suffering from stroke, ataxia or other cerebrovascular or neuromuscular gait disorder are provided for recording by the Emory University Medical School Hospital and its allied health care institutions. Recordings are made in the Kinesiology Laboratories of the Emory University Center for Rehabilitation Medicine.

Subjects are asked to stand on the force platform without the aid of additional support if at all possible. Each subject is asked to stand with feet apart in a comforable position and then shift his weight first forward and backward and then in the left and right directions, and sustain the inclined postures for a period of time. Patients unable to stand by themselves will be tested using various assist devices (i.e., crutch, cane, or bench). Testing of patients sitting on a backless chair enables evaluation of severely acute stroke subjects who are not yet able to stand on their own. Using a polygraph, continuous recordings are obtained of the excursion of the center of pressure. The center of pressure records are transposed to an x-y plot depicting the shifting in center of pressure during standing and weight shifting activities.

FINDINGS TO DATE: In the last progress report it was noted that problems were encountered which delayed the progress of the project. These problems included the fact that insufficient funding was allocated to purchase the required instrumentation, and subsequently in-house construction was being attempted. When other circumstances began to impose considerable delay in this project, appropriate funding was re-allocated, and the instrumentation was purchased. With this new instrumentation it has been possible to move ahead on the patient testing aspects of this project.

To date we have been able to evaluate results from 25 control subjects. We have not as yet done statistical analyses on these data, but several observations can be made by inspection. It appears as though there is relatively little difference in the postoral stability and steadiness of subjects tested either with shoes on or with shoes off. Most of these observations were based on a comparison between barefoot stance and stance in normal low, flat street shoes.

Evaluations are also being conducted to determine the optimum stance required for uniform data. Intuitively, requiring a subject to stand with feet directly together would bias the data inasmuch as it would create an artificial unsteadiness. Likewise, requiring the subject to stand with an extremely large stance would also bias the data. It was hypothesized that the "military stance" (feet approximately shoulder width apart) should result in basically the most stabile stance. To evaluate this, normal subjects have been asked to run through a series of foot stance tests consisting of normal upright standing posture with each test having the feet spaced progressively wider. For uniformity the measurement of foot spacing was obtained between the medial malleoli of the subject. By inspection of the data it was noted that a spacing ranging between 5 and 25 centimeters resulted in approximately the same stability. consequently. at the present time we are testing subjects with a uniform foot separation of 13 centimeters between medial malleoli.

APPLICABILITY:

Intelligent use of services available to the hemiplegic calls for quantification of many of the diagnostic and therapeutic procedures currently being utilized. This research is intended to provide a new quantification technique for evaluation of neuromuscular function, and correlation of these findings with other clinical diagnostic tests and with specific courses of therapy.

108 Measurement Correlates in Chronic Low Back Pain; EMG Studies, Personality Profiles, Functional Performances, and Their Changes Following Sympathetic Blocks

Principal Investigator:	**Steven F. Brena, M.D.**
Co-Investigator:	**S. Wolf, Ph.D.**
Status:	**Continuing (Extension Requested)**
Dates:	**November 1976-October 1977**

Emory University

Cost:	**Annual $24,482** **RT Annual $8,609**	**Projected Total $24,482** **RT % of Annual Total 35.5%**
Annual Report Reference:	**#13, Page 29, R-60**	

OBJECTIVES: To determine the effectiveness of lumbar sympathetic blockage in alleviating chronic low back pain without accompanying physical rehabilitation by:

a. Monitoring paravertebral muscle activity before, during and following sympathetic blockage and placebo (measured in quantifying units following analog to digital conversion of electromyographic data from low back musculature; angular degrees of change in back and hip mobility evaluated as trunk flexion over hip and straight leg raising);

b. Examining personality profiles before and following lumbar sympathetic blockage and placebo (administration of the Minnesota Multiphasic Personality Inventory (MMPI) measured in numerical units as a standard deviation);

c. Correlating changes in personality or neuromuscular states with objective functional improvement following block therapy and placebo (analysis of measurements stated in (a) and (b) to which is added a patient self-evaluation, UPTIME, defined as the amount of time that the patient spends standing per week as measured in hours).

METHODOLOGY: Patients are assigned randomly to one of two conditions initially in a cross-over design: (1) six sympathetic blocks over a two week period (three injections/week); and (2) six placebo blocks over a two week period (three injections/week). Psychogalvanic measurements are taken at all six sessions for each treatment condition. Other data being collected before and after the first treatment and after subsequent treatment sessions include: EMG and joint range of motion. MMPI information is obtained before first treatment and following the 12th treatment, one and three months after the last treatment.

FINDINGS TO DATE: Data are now being processed. The code could not be broken until after all the subjects had completed the study.

APPLICABILITY: Data have shown that each year seven million Americans are disabled by low back pain, with a consequent loss of 200 million man-days of work. Cases have been observed both at the University of Washington Pain Clinic in Seattle and the Emory University Pain Clinic in Atlanta where patients with chronic back pain have had as many as 10-15 back surgeries with no relief of pain, at an estimated cost to society around $100,000 per patient. Data collected at the Emory University Pain Clinic suggest that sympathetic block therapy structured in an operant conditioning program for pain behavior control is of value in rehabilitating patients to function despite well documented conditions of chronic degenerative spine disease. The clinician confronted with problems of chronic back pain which have failed to respond to surgery has no other choice than to put the patient on analgesic and tranquilizing medication, ultimately leading to disability through drug habituation and abuse.

Information about the value of sympathetic block therapy as a technique for pain-control could facilitate functional rehabilitation of patients previously limited by pain and concomitantly reinstate those unfortunate individuals into productive and meaningful lives.

Rt7

Tufts University (RT-7)
Medical Rehabilitation Research and Training Center

CORE AREAS

Biomedical Engineering

Using modern technology to develop products for environmental modification and improved communication for persons with severe physical disabilities.

Consumer Involvement

Research into the state-of-the-art and development of models for meaningful participation in the rehabilitation process by persons with disabilities.

Universe of Need/Patient Care

Activities which have resulted in the development of a computerized functional assessment and outcome evaluation system for medical rehabilitation facilities.

TUFTS UNIVERSITY

Carl V. Granger, M.D., Director
Tufts University Medical
Rehabilitation Research and Training Center
185 Harrison Avenue
Boston, Massachusetts 02111

PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

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PROPOSED

Feasibility of Independent Living Trainers in a Transitional Rehabilitation Education Program

Voluntary Control of Autonomic Functions by Spinal Cord Injured Persons: A Practical Application of Biofeedback in the Treatment of Hyperthermia and Postural Hypotension

109 Electronically Aided Instruction for the Severely Disabled Non-Vocal

Principal Investigator:	**Richard A. Foulds, M.S.**	
Status:	**Completed**	
Dates:	**November 1972-October 1978**	
Cost:	**Annual $61,204** **RT Annual $31,764**	**Projected Total $260,752 (RT)** **RT % of Annual Total 52%**
Annual Report Reference:	**#12, Page 135, R-25**	

OBJECTIVES:

1. Seek out successful utilization of the Tufts Interactive Communicator in both the Vocational Rehabilitation and Special Education departments of the New England states.
2. Identify additional needs of the non-vocal population and develop alternative man-machine interfaces.
3. Communicate with all centers using communication equipment developed by RT-7 and follow-up on the clients using the devices.
4. Communicate with other researchers in the field of nonvocal communication and share experiences and results.
5. Communicate with other researchers in the field of non-vocal communication and share experiences and results.

METHODOLOGY:

1. Identification of potential users in special needs programs and the training of local staff in the operation of the TIC.
2. Follow-up and possible relocation of the ten devices placed under a similar program during 1975. (Items 2 and 3 utilize the reporting forms developed during 1975. The reader is referenced to Project 25 of the 1974-75 Annual Progress Report of RT-7 for these forms).
3. Design of a less sophisticated communicator which displays symbols rather than orthographic characters (The Symbol TIC or SymTIC) based upon requirements of six special needs classroom teachers. These six locations are to be provided with a device.
4. Develop a more powerful communicator which includes word and sentence processing, and more flexible editing.
5. Develop a new interface that will take advantage of the more controllable hand control exhibited by many severely involved cerebral palsied individuals. This will follow the readily available literature on lapboard or letterboard design.

FINDINGS TO DATE: This project has resulted in the design and development of two significant communication devices. The Tufts Interactive Communicator has become the model scanning communicator in the United States. The scanning procedures developed in this project have been transferred to numerous efforts (both private and commercial) nationwide. The non-profit production capabilities of the Tufts RTC have allowed over 80 units to be placed with clients at a reasonable cost. Presently the TIC is very much in demand and a plan for commercialization is being formulated. The current project #67 will combine the outcomes of this project and R-44 into a smaller, more versatile communication device, and will see it through to commercialization.

The second device of importance is the tactile Tufts Interactive Communicator. This represents a totally programable concept where an individual's personal lapboard or wordboard can be converted into an electronic communicator. Eight of these will have been delivered to the Massachusetts Department of Education by the Fall of 1978.

APPLICABILITY: Learning is very slow for children with communication problems, even in the special education classroom. The development of such a system promises to accelerate this pace and to provide a dynamic interaction between teacher and student which is necessary for effective teaching. Such a system will free the class teacher from individual drill work and allow more time for creative lesson planning or specialized instruction.

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110 Project to Document the Development of a Cooperative Group Residence for Severely Physically Disabled — Boston Center for Independent Living, Inc.

Principal Investigator: Paul Corcoran, M.D.

Status: Completed

Dates: August 1974-October 1976

Cost: Annual $776 — Projected Total $13,560 (RT)
RT Annual $-0- — RT % of Annual Total -0-

Annual Report Reference: #12, Page 227, R-55

OBJECTIVES: This project was designed to (1) assist in the development of a group residence on the Boston University Campus, (2) document the process, and (3) evaluate the first year of operation.

METHODOLOGY: A coalition of state agencies, institutions and interested individuals pooled energy, information and resources to fund and staff an action-oriented non-profit organization capable of training severely disabled persons to manage their own lives outside of an institutional setting. With the cooperation of Boston University, rooms in a dormitory were made accessible and students were enrolled in the program. Success with the first nine students led to expansion. To date, 90 individuals have participated in the BCIL program; many are now living independently.

FINDINGS TO DATE:

The process at BCIL involved three stages:

a. Transitional living. Initially on the Boston University campus, this has since broadened to include several other sites. One is a modern, accessible housing project in Brookline, MA. The program is a first, structured step in introducing the physically disabled individual to a working knowledge of his/her disability and basic life skills, preparatory to directing one's own Personal Care Assistants.

b. For motivated individuals with severe limitations, Cluster Housing developed as an intermediate step, with minimal structure and peer support in apartments more integrated with the community at large.

c. Independent living: Individuals are assisted in locating accessible apartments in the community at large. Often these apartments are shared with live-in Personal Care Assistants whose services render the physically disabled individual more independent.

Out of this three stage process, we have determined that the final goal, independent living, is feasible, realistic and cost competitive. BCIL facilities are less costly than a Level I nursing home or a chronic care facility.

APPLICABILITY: The success of this program to date (in the face of some acknowledged administrative difficulties) has demonstrated that independent living is a meaningful and realistic goal for persons with severe physical disabilities. We are now using BCIL veterans to develop programs which, extended to include rehabilitation professionals and beginning earlier in the rehabilitation process, will provide more incentives to encourage physically disabled individuals to strive for a life more productive than previously believed possible. Thousands of copies of the BCIL Reports have been given to persons around the country who have expressed interest in developing independent living centers. Summary articles by Drs. Fred Fay and/or Paul Corcoran have appeared in several national publications and a 13 minute videotape documentary has been developed by BCIL.

111 Evaluation of the Feasibility of a Twelve Week Physiologically Paced Conditioning Program with Measures of Physiologic, Functional and Psychologic Factors in Hemiparetic Patients.

Principal Investigator: Theresa A. Hoskins, R.P.T., M.S.

Status: Completed

Dates: November 1974-September 1977

Cost: Annual $24,592 — Projected Total $46,515 (RT)
RT Annual $20,812 — RT % of Annual Total 85%

Tufts University

Annual Report Reference: **#12, Page 297, R-57**

OBJECTIVES:

1. To demonstrate the feasibility of having hemiparetic patients participate in a 12 week physiologically paced conditioning program.
2. To identify factors which interfere with the completion of the 12 week conditioning program.
3. To obtain measures of physical, psychological, functional, physiological variables prior to, during, and at the end of the 12 week conditioning program to determine if there is a relationship among any of them and between each of them to compliance with the program.

METHODOLOGY:

1. Hemiplegics who were discharged from the Rehabilitation Institute, who were screened by the physician in charge of out patients for exercise testing were recruited for pre testing. Criteria for admission to the program were: at least 6 months after CVA with complete medical stability, lack of symptoms of cardiac disease especially during exercise stress test, neuromuscular function at a plateau, and motivation to participate in a conditioning program for 12 weeks.
2. The exercise pre test included physiologic measures during two 5 minute sessions of submaximal bicycle exercise on an ergometer. Measures during steady state included: EKG, heart rate, blood pressure, respiratory rate, tidal volume, minute ventilation, and oxygen uptake. On the basis of the patient's response to this test, a decision about the safety of entering the program was made, and an exercise prescription assigned.
3. Psychological variables were measured for self concept variables, using the Social Vocabulary Index and the Tennessee Self Concept Scale.
4. Functional variables were measured: ability to climb and descend stairs, ability to walk 50 yards on level, ability to comb hair with affected arm, ability to tie shoe laces with two hands, ability to write name, interview to obtain Barthel Score.
5. A regular schedule of exercise over 12 weeks, 3 days each week, for 1/2 hour of stationary bicycle exercise under supervision was instituted. Progression of training was made via increasing the work load, and decreasing the resting phase on an interval schedule of pedaling. Each patient was progressed according to his own tolerance, limitations and exercise prescription.
6. Each session records were kept of resting heart rate blood pressure, submaximal exercise heart rate response, submaximal exercise blood pressure response, work load used for each submaximal exercise, exercise to rest time ratio. After 6 weeks and again at 12 weeks ventilatory function in response to exercise and oxygen uptake at submaximal exercise were taken. Also at these points, self concept variables and functional changes were recorded.

FINDINGS TO DATE: Five females and three males have completed 12 weeks of bicycle exercises on a three day per week, thirty minute session schedule. Two of three males adhered faithfully and enjoyed the program, but the third man missed frequently, was depressed throughout. All but one female finished the 12 week program, and she terminated her program for personal inconvenience reasons after 8 weeks. The remainder of the females enjoyed the program.

Heart rate responses to a constant work load were lower in all but one subject for whom there was very little change over the total program. This indicates a greater efficiency of cardiovascular function after training.

Predicted oxygen uptake values were improved in all except the one depressed male patient. The amount of improvement did not correlate well with the adherence to the schedule.

The group as a whole exhibited positive self concept benefits of participation. The starting scores were significantly different from the published norms, but were brought into the range of normal by the end of the program. There was only one exception to this, which was the Physical Self Score (how one sees one's body, state of health, physical appearance, skills and sexuality), which remained significantly different from normal.

Functional improvements were variable. One of the 3 males had a marked improvement, with reduction in spasticity resulting in improved gait, and greatly improved endurance. The other two males showed very little functional change. Three of the five women showed marked functional improvements, including greater stamina, and greater awareness of sensation in the affected side.

APPLICABILITY: If feasibility is demonstrated for hemiparetic patients by this investigation, this will provide a rationale for a new type of rehabilitation service for patients who have hemiplegia, which may be of benefit in increasing their overall confidence and function. Future studies may then be implemented to investigate the effects of this type of exercise especially in cases of patients with multiple handicaps, using specially adapted exercise equipment.

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Tufts University

112 Federal Hearing on Recreation and the Handicapped

Principal Investigator:	**Janet A. Minch, M.A.**	
Status:	**Completed**	
Dates:	**October 1976-May 1977**	
Cost:	**Annual $37,204** **RT Annual $32,169**	**Projected Total $32,169 (RT)** **RT % of Annual Total 86%**
Annual Report Reference:	**#12, Page 241, R-61**	

OBJECTIVES: This project had three objectives, all of which were achieved:

1. to bring together knowledgeable and concerned experts in the area of recreation needs of handicapped individuals to formally set down the current state-of-the-art with respect to recreation for the handicapped;
2. to receive expert opinions, observations, and recommendations regarding recreation needs of handicapped individuals from prominent professionals in the field, consumer representatives, administrative officials, and other interested parties;
3. to develop a final report of the hearing's findings for the ATBCB and the Department of the Interior.

METHODOLOGY: A cooperative effort by Tufts RT-7, the ATBCB, the Department of the Interior (DOI), and several other organizations and individuals suceeded in providing all phases of preparation, recording and analysis of the hearings. Three specific RT-7 tasks in conjunction with the hearing dealt with arrangements for the hearing:

1. RT-7 staff first established contact with the National Recreation and Park Association and the Sheraton Boston to verify certain physical arrangements for the recreation hearing and to make other arrangements including housing and transportation, to assure a productive hearing;
2. Staff arranged for amplification and recording of the proceedings of the hearing and made arrangements for and employed a court reporter to provide a verbatim transcript of all hearing proceedings.;
3. Staff received a list of all examiners and witnesses attending the Boston hearing and made necessary room and travel arrangements.

Following the hearing, RT-7 received the transcript from the reporter and prepared a final report consisting of:

A. An abstract of the presentation and cross-examination of each witness at the hearing including his or her suggested recommendations and options.

B. A categorized analysis of the entire testimony which reflects a factual synthesis of various areas of concern.

C. A list of formalized recommendations resulting from the hearing.

The final report has been submitted to the Architectural Transportation Barriers Compliance Board.

FINDINGS TO DATE: The following recommendations are based on analysis of the testimony provided in the recreation hearing. They are, in a sense, a consolidation of individual opinions; they reflect what the majority of witnesses presented as key actions for follow-up on the hearing.

Meaningful policy, program, or practice changes would derive from implementation of the final recommendations:

A. Initiate and Implement National Policies that Demand Compliance with Existing Laws

1. The President should direct agencies to implement action programs and policies on Public Laws 90-480 and 93-112 that aggressively support as a high priority the needs of disabled citizens.
2. Incentive fundings and priority policies should be developed and implemented to bring existing facilities and transportation systems into compliance with current accessibility laws.
3. Barriers to employment, such as those discouraging the hiring of qualified personnel who understand the needs of disabled persons, should be removed and affirmative action policies upheld.

B. Develop Appropriate Recreational Resources.

1. A national public policy on recreation for disabled children, youth, adults, and elderly should be developed.

2. Recreational program services for disabled persons should receive higher priority and thus a greater portion of available and new funds.
3. An information center on the recreational needs of disabled persons, resources, and research should be established to communicate information to disabled consumers, recreation professionals, and the general public.
4. Mechanisms that involve disabled individuals and their representatives in meaningful roles in program planning, development, and evaluation should be required.

C. Stimulate Research in Recreation for Disabled Persons.

1. Funds should be awarded to explore the use of outdoor space by disabled persons and to refine design standards.
2. Research grants should be available to develop new technologies, equipment, and programs for use by disabled persons in recreation.
3. Criteria for planning and design should be developed that encompass the quantity and quality of use of recreational space by handicapped persons.

APPLICABILITY: The final report included abstracts of testimony, analysis of information presented, and recommendations. The report was submitted to the Architectural Transportation Barriers Compliance Board for delivery to the President and Congress and was distributed to numerous public and private agencies.

113 Access to Careers in Science: A Feasibility Study to Establish Communication Linkages to Optimize Career Choices for the Severely Disabled Student in Higher Education

Principal Investigator:	**Martha Redden, Ed.D.**	
Status:	**New/Continuing/Completed**	
Dates:	**November 1976-October 1978**	
Cost:	**Annual $26,216** **RT Annual $22,668**	**Projected Total $47,043(RT)** **RT % of Annual Total 86%**
Annual Report Reference:	**#12, Page 263, R-64**	

OBJECTIVES: The first major objective of the project is to enhance the career oportunities available to disabled persons.

The second major objective of the project is to test the effectiveness of involving consumers (the disabled students and scientists) in planning, delivery and evaluating a specific rehabilitation service (the community network).

METHODOLOGY: A coalition of Tufts RT-7, American Association for the Advancement of Science Opportunities for Handicapped Individuals in Science (AAA/S), The American Coalition of Citizens with Disabilities, University of Massachusetts/Boston Disabled Students Program, and ABT Associates has developed the original plans for the communication network feasibility study. Disabled scientists identified by the AAAS and disabled students will play a vital role in the project. The project is guided by and aimed primarily at the needs and concerns of a major consumer group -- the severely physically disabled student preparing for a scientific career.

Martha Redden (Director, AAAS Opportunities for Handicapped Individuals in Science) and Wayne Fortunato-Schwandt of the same office will be primarily responsible for coordinating Boston and Washington activities, and maintaining responsibility for the budget and dissemination of the newsletter.

Under supervision from Andrea Schein, Director of the Resource and Counseling Center for Handicapped Students at University of Massachusetts/Boston, the bi-monthly newsletter is compiled and edited by disabled college students. The project staff has selected an editorial board of disabled college students living in the Metropolitan Boston area. The editorial board works an average of four hours a week including regular general meetings. It is the responsibility of this board to solicit articles for publication, prepare written materials, make decisions regarding the appropriateness and general interest of materials received, edit and prepare a lay-out, and produce editorial writing. The board presents and discusses work in regular meetings with the project staff. The editorial board prepares the final draft of the newsletter for publication by the deadlines established by the project staff. The final typing, printing and mailing of the newsletter is done by AAAS. Each issue contains a description of the sponsoring agencies, funding source, and editorial board. In addition, a question and answer column offering technical assistance on campus accessibility and on Sections 503 and 504 is contributed by Cheryl Davis.

The mailing list of the newsletter is made up of college disabled student programs and/or organizations, disabled scientists, consumer organizations of and for disabled individuals, science departments, college administrators, selected scientific professional societies, and, as a result of additional funding from the Bureau of Education for the Handicapped, high school guidance counselors.

Frederick Fay, Tufts RT-7 Director of Research, has overall responsibility for evaluation of the project. The major sources for data for the evaluation are (1) structured feedback from project staff and consultants, including written reports on editorial board meetings (2) written structured evaluation forms included in the first and last issues of newsletter and (3) unsolicited comments comments.

Tied in with each of the three evaluation measures will be items related not only to the communications network itself, but also to the method by which it is implemented. In other words, specific measures will examine the impact of the "consumer service provider," that is, the disabled students and disabled scientists in planning and delivering the rehabilitation service (newsletter). A variety of methodological issues (e.g., paid vs. unpaid consumer involvement, optimal consumer/provider mix in service delivery, impact of specific approaches, etc.) will be analyzed.

FINDINGS TO DATE: The findings and the overview on the development of this research are detailed in the report. This publication specifies the informational needs within education and scientific communities regarding implementation of Section 503 and 504 of the Rehabilitation Act of 1973 as it pertains to severely physically handicapped individuals who are pursuing higher education degrees.

Additional information contained in the report evaluates the use of severely physically disabled persons as part of the development process for the publication. Impacts and results are specified.

Several key questions covering the usefulness of this communication network are included in the evaluation section.

APPLICABILITY: This study will provide policy makers at colleges and universities with information on how to develop greater opportunities for severely disabled students on their campuses. Thus a major anticipated immediate program and practice change takes place as colleges implement ideas presented through the proposed communications network.

114 Research in Upper and Lower Extremity Orthotics

Principal Investigator:	**James O'Leary, M.S.**	
Status:	**Continuing**	
Dates:	**January 1971-October 1979**	
Cost:	**Annual $36,546** **RT Annual $18,998**	**Projected Total $102,663 (RT)** **RT % of Annual Total 52%**
Annual Report Reference:	**#12, Page 133, R-24**	

OBJECTIVE: To investigate methods of manufacture which will make light weight orthotics more readily available.

METHODOLOGY: Experience in experimentally fabricating orthoses indicates that the process of forming from plastic sheets is relatively easy to master as a task. It does, however, require a significant investment in training time to master these skills.

Improvements are being sought in fabrication methods and design of these devices which will reduce the initial cost of gaining lightweight orthotics capability. The vacuum forming process reduces the learning effort required, but commercially available equipment for this process is expensive. Development of an inexpensive vacuum forming system to be used in an orthotist's work area has been a primary step in this project.

A system which meets these needs was designed earlier in this project and is currently in use in nine locations. This usage is being evaluated for possible problems or areas where improvement could be obtained.

Further effort is required in the area of orthotic design that utilizes the properties of polypropylene. The use of the vacuum forming system in the fabrication of orthoses other than the ankle-foot device is presently being investigated.

FINDINGS TO DATE: The project has concentrated on the effort to develop more effective utilization of vacuum forming systems through the inclusion of other orthotic and orthopedic devices as possible products from such a system. Work has progressed on the plastic knee brace, as well as a variety of long leg orthoses.

Design of the existing vacuum forming system has been stabilized and described in various publications. Units built by the BMEC have been provided to Moss Rehabilitation Hospital, The Veteran's Administration, and RT-3 at the University of Washington at Seattle. A fourth unit has been provided to the University of Washington for use in their project is South America. Certain design changes may result from reports from these locations.

The design of a large sized vacuum forming table which can accept molds the size of wheelchair parts has been completed. Technology similar to the smaller table was used in order to make this a cost effective device. Construction was accomplished during the summer of 1977.

Custom fitted polypropylene foot-ankle orthosis has a problem regarding an increased occurence of breakage. The failure has predominantly been in the ankle area and has been brittle in nature. For this reason, tests were conducted to determine the causes of these failures. Three different sample groups were tested. These include: (1) samples exposed to sunlight for long periods, (2) samples heated and rapidly cooled, as in the brace forming process, and (3) samples to determine the edge effects, rough edges vs. fire polished.

Each of these groups were put through a battery of tests which include a low speed tension test, high speed tension test, and a dynamic tension and compression cycle at various speeds. The dynamic test was done in two modes: the first was a force limited test, and the second was a deflection limited test.

From the tests, it was recommended that the cooling rate of the plastic in the forming process be increased substantially from the present rate. This will allow finer crystalization of the plastic and increased fatigue and impact resistance. It is also recommended that the brace be trimmed back in the ankle area, to allow for more flexing when it is possible to do so.

APPLICABILITY: It is expected that this work will result in wider availability of lightweight orthotic devices.

115 Follow-Along Study of a Medically Disabled Population in Fall River, Massachusetts: A Controlled Trial of Surveillance as a Means to Support Functional Independence

Principal Investigator:	**Carl V. Granger, M.D.**	
Status:	**Continuing**	
Dates:	**November 1973-June 1978**	
Cost:	**Annual $37,551** **RT Annual $29,388**	**Projected Total $106,439(RT)** **RT % of Annual Total 78%**
Annual Report Reference:	**#12, Page 35, R-35**	

OBJECTIVES:

1. To determine if follow-along of patients discharged from a hospital rehabilitation unit who are under the surveillance of case aids can reduce the number and severity of acute medical care incidents or hospitalizations and/or chronic institutionalizations;
2. to test whether periodic objective and comprehensive assessment of functional capacity in these patients provides a practical measurement of outcome and/or provides a useful indicator of sustained capacity and maintenance care needs of rehabilitation patients.

METHODOLOGY:

1. The study group will consist of patients discharged from rehabilitation treatment and evaluation

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programs in the greater Fall River area during the 18-month period following the beginning of the study. The study group will be stratified on the basis of a five category diagnostic procedure. Each member of the study group upon discharge from the rehabilitation treatment program will be randomly allocated to one of three groups of about 75 patients.

2. Group I will be kept in contact by case aides who will note any change in functional capacity subsequent to discharge. Changes will be evaluated by a professional rehabilitation team which, in addition, will evaluate the group upon admission to and discharge from the rehabilitation program and at 6 and 12 months after discharge. Appropriate rehabilitation steps will be taken on the basis of those evaluations.
3. All members of groups 2 and 3 will be evaluated by a professional rehabilitation team upon admission to and discharge from the rehabilitation program, at 6 months after discharge (for group 2 only) and at 12 months after discharge. Appropriate rehabilitation steps will be taken on the basis of each evaluation.
4. Measurements of the functional life status and quality of life status will be taken of each member of all three groups on admission, discharge, and one year after discharge. Outcome measures pertaining to hospitalization, instutitionalization, medical status, and medical care services will also be obtained for all members of the three groups for the one year period following discharge. The Programmed Summary of Functional Status (PSFS) and a Quality of Life Measures will be used.

FINDINGS TO DATE: A joint program in rehabilitation research has been established between the Tufts Rehabilitation Institute and the Hussey Hospital in Fall River. The PSFS has been applied on 150 patients in the Fall River area with satisfactory results. A social interview is being developed. This will include quality of life measures previously developed and utilized in a number of other research studies. Arrangements are being made with the Home Health Agency of Fall River for the services of the case aides who will provide the follow-along intervention surveillance.

A total sample has been developed of 142 persons: 41 in Group I, 49 in Group II and 52 in Group III. The mean age is 58.9. After attrition due to death, moving away or loss to follow up by refusal, 114 persons completed the post-test interviews. Analytic techniques will be used to test change in functional status between pre-test and post-test and to determine the impact of the medical monitoring and friendly visitor intervention.

APPLICABILITY: There is a great need for the development of a program to evaluate the follow-along approach to the care of chronic rehabilitation patients as well as more efficient medical care delivery with fiscal containment. This program is concerned with both areas as well as the development of more specific information on the functional assessment of patients.

116 Medical Rehabilitation Evaluation - Office of Technical Assistance

Principal Investigator:	**Carl V. Granger, M.D.**	
Status:	**Continuing**	
Dates:	**November 1973-October 1978**	
Cost:	**Annual $55,855** **RT Annual $37,574**	**Projected Total $208,793(RT)** **RT % of Annual Total 67%**
Annual Report Reference:	**#12, Page 41, R-36**	

OBJECTIVES:

1. To optimize hardware and software configurations on the PDP 11/70 Standard Mumps Computer System to permit the most rapid and efficient data entry, storage and retrieval, with maximum flexibility for data display and statistical analysis.
2. To enlarge the data bank to accommodate patients/clients of diverse types and settings and to add assessment modules for specialized problems of arthritis, mental and emotional impairments, communicative deficits and growth and developmental disabilities.
3. To add multivariate statistical analysis and cost data to the functional assessment system.
4. To experiment with different display formats for management and program evaluation reports to determine those that are likely to reflect accomplishments of rehabilitation, difficulties in case management, and to indicate areas and directions for corrective action or improvement.
5. To continue to test the validity of functional assessment levels as compared to needs, services

rendered, outcomes achieved, efficacy of therapeutic interventions, counseling and costs.

6. To develop "prognostigrams" for predicting likely outcomes.
7. To assist interested rehabilitation facilities in participating in the evaluation system through technical consultation and advice.
8. To extend functional assessment into the training experience of rehabilitation and health care workers such as residents in PM&R, nurses, therapists and counselors.

METHODOLOGY: A tested and established system of data collection called Long Range Evaluation Summary (LRES) using coded worksheets is in operation. Computer systems are operational at Tufts New England Medical Center (PDP 11/70, MUMPS language) and at The Memorial Hospital (IBM 370, COBOL) for inputting data and producing patient reports. Software programs are being developed to accommodate diverse patient/client populations, to produce management and evaluation reports and permit interchange of data between the two systems.

FINDINGS TO DATE: This project is a continuation and expansion of the prior project, "Computer Retrieval of Data for Long Range Evaluation Studies of Medical Rehabilitation." The computerized patient/client record technique allows tracking of individuals served through various programs of care, judging of degree of severity of disability through objective measures, and allows comparison of outcomes of treatment for various individuals. Training workshops are conducted several times per year to teach the method of functional assessment.

117 Computer Aided Motor Communication for the Severely Disabled Non-Vocal

Principal Investigator:	**Richard A. Foulds, M.S.**	
Status:	**Continuing**	
Dates:	**November 1973-October 1978**	
Cost:	**Annual $33,910** **RT Annual $28,632**	**Projected Total $158,475 (RT)** **RT % of Annual Total 84%**
Annual Report Reference:	**#12, Page 159, R-44**	

OBJECTIVES: The research will be directed towards maximizing the motor communication rate of the severely disabled non-vocal person through the use of a high speed digital computer. Several noncomputerized communicators have been developed in recent years which interpret "yes" — "no" commands and allow the motivated client to communicate at a rate of up to 12 words per minute. This is well below the speed of an average typist (approximately 55 words per minute) and far below the rate of human speech which can exceed 200 words per minute. The relatively slow rate of those communicators can result in extreme frustration on the part of a user with normal intelligence.

METHODOLOGY:

1. Develop a computer software package which will anticipate the redundant information in a message and thereby increase the motor communication rate. The computer software package will reside in a large general purpose digital computer (most likely the DEC System 10 at Tufts University) and will be accessed over the telephone lines. Program evaluation will be performed on a cathode ray tube (CRT) display terminal.
2. Do exploratory studies on normal individuals interacting with the "intelligent" communicator to establish its utility. A baseline for motor communication rates will also be established at this time.
3. Once the programmable communicator is functional, it will be introduced into the special education classroom for use. Progress of the students in their reading and writing abilities will be assessed both before and after the introduction of "intelligent" communicator to indicate their progress.

   Based upon the exploratory studies, a prototype communicator will be developed which will be integrated into a clinical setting. Tests will be performed to determine the increase in communication output rate (if any) and to identify difficulties in the man-machine interface. These difficulties will become the focus of future design efforts.

FINDINGS TO DATE: The concept of anticipatory scanning based upon statistical information has offered ideal typing improvement since the early analysis of the data. The engineering effort has been aimed toward developing the appropriate human-machine interface and the hardware development necessary to put a device into a clinical testing situation.

The major accomplishment of this past year has been to refine the concept of a dynamically scanned keyboard that was introduced in the RT-7 Annual Report for 1975-76.

This system not only reduces the amount of time required to output a message, but also reduces the amount of physical effort required to make that output.

Each of the two dynamic characters will require only a single switch signal. Since they potentially represent 75-80% of the choices, there will be a reduction of 35-40% of physical effort. The typing rate is improved by nearly 40% depending upon the message.

APPLICABILITY: The development of an "intelligent" communicator which can increase the motor communication rate of a severely disabled non-vocal individual should have a profound effect on all his social encounters. Among other things, it may allow a more valid assessment of the intelligence of such an individual by bypassing his motor disability.

The importance of effective communication in rehabilitation cannot be overstressed. The need for a means of expressing desires and feelings is one that must be satisfied in all people regardless of their disability. The importance of this project is that it will allow a person to perform at the highest level of his ability. As described in the introduction to the Biomedical Engineering core-area of research, this project is consistent with RSA research objectives in Research and Evaluation Area "N", Rehabilitation Engineering.

118 Auditory Feedback as it Relates to Language Acquisition and Utilization with the Severely Physically Disabled

Principal Investigator:	**Richard Foulds, M.S.**	
Status:	**Continuing**	
Dates:	**July 1976-October 1979**	
Cost:	**Annual $28,195** **RT Annual $27,045**	**Projected Total $124,808 (RT)** **RT % of Annual Total 96%**
Annual Report Reference:	**#12, Page 148, R-58**	

OBJECTIVES: The primary objective of this project is to study the usefulness of auditory feedback (as provided by synthesized speech) in the expressive language development of the nonvocal individual. This will be accomplished by:

1. The creation of a prototype device which will provide appropriate interfaces for the user, visual feedback, and auditory feedback.
2. Testing of the system with several nonvocal individuals specification of the device options based on data from the pilot study.

METHODOLOGY: The methodology includes the design of the prototype device using the laboratory computer (PDP 11/20), a Votrax VS-6.4 voice synthesizer, and various interface systems made available through other RTC communication projects. The system accepts a phonemic input from one of the interfaces and displays that phoneme graphically on a video monitor. Simultaneously the synthesizer responds with the spoken utterance. Following a "space" selection, the synthesizer speaks the word by joining all of the previously chosen phonemes.

Once the hardware has been tested, a procedure for training is implemented. The Goldman-Lynch sounds and symbols set has been chosen. The orthography of the set is compatible with the video monitor, and the curriculum is well documented for teaching to the project subjects.

Several subjects will be taught to use the system in order to observe its effects upon the communication procedure.

FINDINGS TO DATE: To date, the computer prototype has been made operational. Three subjects are currently being trained on the system using a modified Goldman-Lynch Curriculum. Results will be forthcoming. Also of importance has been the development of modifications to standard language tests. The Carrow and Peabody test have been successfully modified to allow for minimization of error due to motor dysfunction.

APPLICABILITY: It is hoped that the results of this project will lead to an improvement in expressive language in the nonvocal individual. This project is seen as a basis from which further studies in language (Ref. Project R-69) and voice synthesis (Ref. Project R-68) can continue.

119 The Effect of Home Modification on the Functional Performance of the Physically Handicapped

Principal Investigator:	**Jonathan C. Bretz, B.S., O.T.R.**	
Status:	**New/Continuing**	
Dates:	**July 1976-October 1978**	
Cost:	**Annual $44,418** **RT Annual $35,381**	**Projected Total $66,751 (RT)** **RT % of Annual Total 80%**
Annual Report Reference:	**#12, Page 183, R-59**	

OBJECTIVES:

1. To determine the extent to which structural modifications of private dwellings (homes, apartments) improve or heighten the functional performance of physically handicapped persons living therein.
2. To apply measurement instruments of functional assessment to persons with disabilities in inaccessible and accessible home structure before and after architectural modifications.
3. To present data on the benefits and costs of the Rehabilitation Adaptation Service project to health insurance companies and other fiscal third-party agencies (e.g. Medicaid, Medicare) and to encourage them to add Rehabilitation Adaptation Services coverage to their policies.
4. To facilitate future investigation of the relationship between functional performance in the homes of physically handicapped individuals and home modification.

METHODOLOGY: For purposes of this research project, candidates for home modifications were screened on three criteria:

1. ability to perform activities of daily living is limited due to a physical disability (i.e., persons who are paralyzed, required ambulation aids, have neurological diseases, etc.);
2. live within a forty mile radius of T-NEMC;
3. are willing to have functional assessment evaluations administered before and after modifications are made (for purpose of this research project, requirements were more stringent that standards that might be developed by independent or state agencies.)

Early in the project, a brochure was designed and sent to professionals with clients who might meet the requirements. Referrals could be made to the project coordinator by telephone for consideration as a study participant.

The modifications undertaken by this study were limited to $500.00 per client, partly due to budget constraints, but mainly to extend the revenue to as many people as possible. To date, the most impressive outcome of this project has been the number of low-cost modifications: at the end of the first project year (October 30, 1977), the average cost per client (total 23 clients) was $397.93. This includes ramps, bathroom and kitchen modifications, threshold removal, and door widening.

Once referred, the next step involved a carpenter and an O.T.R. to determine, by home assessment, exactly what was needed by the individual. Again, if the estimate was within the $500.00 limit, the modification was applicable to this study.

Before the modification was started, an adapted version (developed especially for this study) of the Granger Long Range Functional Assessment (RT-7 Annual Report, 1975) form was administered to determine the present functional level of the individual. Once the work was completed and an appropriate time was allowed for the person to become accustomed to the change (i.e., 6 weeks), the same form was administered again. Any changes in functional independence would show in the analysis of these forms. Further statistics will be obtained through comparison of study forms to those of non-study forms.

FINDINGS TO DATE: The data that has been collected and analyzed to date, appears to show that structural modifications work in increasing a disabled person's functional independence. The functional assessment form used categorizes, depending upon the amount of assistance needed, each participant into one of five areas -- least, slightly, moderately, severely, or profoundly handicapped. To date, the data collected before the modifications were done, placed 10% of the participants in the moderately handicapped category, 60% were classified severely handicapped; and 30% profoundly handicapped. When compared to the final data for these same participants, a discernible difference can be seen - 40% were found to be moderately handicapped, 40% severely handicapped and only 20% profoundly handicapped. Although these results do not include all of the data, it is felt that they are representative of the final outcome.

APPLICABILITY: The investigator recognizes that home adaptation is an important need for the physicallly handicapped person to live independently. As rehabilitation personnel work with the handicapped, they focus on two major aspects. The first is the restoration of function through encouraging the residual abilities of the patient. The second is the adaptation of the patient's environment. The first focus is usually the concern of the rehabilitation team, consisting of the physician, rehabilitation nurse, physical and occupational therapists. The occupational therapist of this team has been traditionally expected to zero in on the adaptations for physically handicapped individuals. Through the use of self-help devices, equipment, etc., an attempt toward independent living is built into the treatment planning. The occupational therapist, therefore, manipulates the environment while teaching the restoration of function. Hence, their involvement with home modifications.

Once the client is sent home, however, many cases occur where those rehabilitation skills attained by this patient in the hospital are impossible to execute due to the need of structural changes in his home. The disabled person confined to a wheelchair views the environment from a different perspective than the able-bodied person. First of all, his height is cut down to the height of the chair. Secondly, his width is added to through the dimension of the chair. Thirdly, this person has difficulty getting through doorways, up to closets, cabinets, under tables, kitchen sinks, using bathroom facilities or getting basic household tasks completed.

The deficiency in proper home structure and adaptation have made it quite difficult if not impossible for some discharged physically handicapped persons to live independently. The medical rehabilitation team may not be able to complete their job of assuring maximum independence of their patient when these home adaptations are not available. Some of the handicapped elderly, for instance, have no other choice but to enter a nursing home. Some of the young disabled go to chronic care facilities -- **an unnecessary waste of human resources.**

Successful vocational rehabilitation is more likely if the person with severe physical disability is able to function independently in his home environment. In particular, if a person cannot get in and out of his home, it is difficult to get to and from work. A major portion of these problems may be remedied by the teamwork of a carpenter and the occupational therapist.

With current pressures on the various third part coverage organizations to cut costs and prevent institutionalization, this service becomes more siginificant from a cost-effectiveness angle. A number of cases have come to our attention where recovery was delayed, accidents happened, hospital stays were prolonged, needless costs were incurred for the services of homemakers and home health aides, or patients went to nursing homes or chornic care facilities, all for the lack of a Rehabilitation Adaptation Specialist.

A major question in both Area A, Universe of Needs, and Area B, Selection and Counseling Process, Areas of the RSA FY 1977 R&E Strategy, relates to functional assessments and other measures used in the Comprehensive Needs Study as well as measures that examine the extent to which the environment is severely handicapping.

The project also ties into Area N, Rehabilitation Engineering. A research objective there is to develop methods of eliminating architectural barriers which hinder the mobility and employment of persons with severe disabilities.

120 Feasibility Study of A Management Training Program for Severely Physically Disabled Persons

Principal Investigator:	**Bruce E. Marquis**	
Status:	**New/Continuing**	
Dates:	**July 1976-June 1978**	
Cost:	**Annual $24,169** **RT Annual $18,194**	**Projected Total $18,577 (RT)** **RT % of Annual Total 75%**

Tufts University

Annual Report Reference: **#12, Page 233, R-60**

OBJECTIVES:

1. Document a detailed curriculum for this on-the-job training program for potential managers.
2. Establish linkages with management schools in the Greater Boston area in terms of their support for the involvement of persons with severe physical disabilities in academic programs in business administration and management.
3. Maintain appropriate supervision of four trainees at primary job sites.
4. Provide a plan of supervision of the trainees in order to assure consistency in expectations toward their performance.
5. Evaluate the progress of the trainees, as well as the appropriateness of the curriculum and the quality of the training settings.
6. Develop career opportunities for the trainees and other severely physically disabled persons in private and public social service agencies and industry.
7. Demonstrate the feasibility of such an on-the-job training program.
8. Document the results of the program after two years and disseminate the data to other pertinent persons and organizations for review and comment.

METHODOLOGY:

1. The curriculum was further developed for use by the trainees, linkages with schools of management were maintained, and the recruitment of trainees was continued.
2. Regular meetings of the trainees and primary personnel were provided to insure proper supervision of the trainees and support for the implementation of the program plan.
3. Evaluation tools in the form of written examinations were utilized; in-depth interviews and observation of on-the-job performance also was used.
4. The research committee worked with industry and social service agencies to develop career opportunities for the trainees.
5. Consumers were involved in all aspects of the planning, implementation, and evaluation of the program.
6. A faculty of able administrators and resource persons continued to instruct mini-courses (6 hours of volunteer time) in the following skill-development areas:

   Board & Committee Work
   Community Organization
   Consumer Involvement
   Educational Methods
   Facility Management
   Fiscal Management
   Fund Raising
   Government Relations
   Interpersonal Relations
   Leadership
   Legal Issues
   Objective Setting
   Planning
   Problem Solving
   Program Development
   Public Relations
   Relations with Professional Community
   Research and Evaluation
   Vocational Rehabilitation
   Volunteer Development

   The mini-courses were open to auditors, who are persons with severe physical disabilities, employed in other settings, and who chose to participate in the mini-courses only.
7. Specialized management training skill development was provided through intensive three-day sessions utilizing American Management Association course materials. Through audiovisuals, guide books, lectures and discussions, information on principles of management and leadership were provided. A grantsmanship course (2½ days long) provided several trainees with intensive skills, useful in present and potential positions.

FINDINGS TO DATE: The first report including evaluation of the research project details the growth of the program. This report isolates several factors to take into consideration in implementing a management training project.

APPLICABILITY: Information from this project is most useful for rehabilitation professionals working with severely physically disabled persons in employment placement and on the job. Disabled persons will find the study informative and useful as they relate the experiences of job trainees to themselves. Persons working on issues of the Rehabilitation Act, Section 503 and 504 should find the information useful. Federal and state rehabilitation services administrators will also gain insight into gaps in service areas and needs of severely physically disabled persons. Rehabilitation agencies should find it helpful in practicing "affirmative action" themselves.

121 Consumer Involvement in Rehabilitation

Principal Investigator:	**Janet A. Minch, M.A.**	
Status:	**New/Continuing**	
Dates:	**October 1976-October 1979**	
Cost:	**Annual $40,892** **RT Annual $35,358**	**Projected Total $103,428 (RT)** **RT % of Annual Total 87%**
Annual Report Reference:	**#12, Page 247, R-62**	

OBJECTIVES:

1. Determine the state of the art in consumer involvement nationwide.
2. Demonstrate the feasibility of model programs of consumer involvement.
3. Explore feasibility of establishing a Consumer Involvement Center.

METHODOLOGY: The methodology for Objective 1 is to develop questionnaires based on information needs to assess Chapter 25 implementation and difficulties. One Questionnaire, designed for use with state agencies, will survey the eighty-one general and blind programs. Another survey questionnaire will be designed to survey a sample of the over 2,000 consumer organizations of disabled persons, to determine their interest in and level of consumer involvement with vocational rehabilitation agencies. A detailed statistical and analytical presentation of survey results will be included in the report as well as discussion of various models.

The Massachusetts Rehabilitation Commission provided funds to explore models of consumer involvement in Massachusetts. Consumer organizations were selected to provide a program service component available to the rehabilitation agency and its clients and a structure for policy consultation to focus on issues of importance to the disabled community. Contracts are agreed to between Tufts and the consumer organizations. Technical assistance and grants management are functions provided by the staff of RT-7. Two model types, Individual Policy Consultation and Consumers as Citizens, are provided directly through Tufts RT-7 to the rehabilitation agency. Program assessment and evaluation will be undertaken by consultants and Tufts program staff. Emphasis is placed on expected outcomes and measures of the degree to which these are realized through program efforts. A final report will detail project methodology of the first nine months of the program. Follow-up evaluations will clarify how the program changes over time.

The methodology for Objective 3 is to involve persons with expertise and experience in the issues facing disabled persons as recipients of service to discuss and explore the feasibility of a Consumer Involvement Center. Through brainstorming sessions, literature and research review, analysis of training needs, inquiries into the rehabilitation community, particular needs and roles will be isolated. If determined feasible, a small group of persons would work together to determine the basic structure and specific objectives of the Center. It would involve nationally recognized leaders, such as Harold Remmes, Frank Bowe, Fred Fay, and others who have personally undertaken activities in this area and who will share information and train others. The Center would have particular capability to serve as a clearinghouse for consumer involvement information, continue ongoing selected efforts that originate within the core area, provide training and technical assistance and other service programs as feasible.

FINDINGS TO DATE: Objective one, the questionnaire for the nationwide study, is still being analyzed and the findings have not been reported.

In the demonstration model project, objective two, the first year evaluation report draws the following conclusions and recommendations for consumer involvement programs in state rehabilitation agencies.

Formalize a Structure for Consumer Involvement

1. Define Agency Consumer Involvement Goals and Objectives
2. Determine an Agency Definition of the Consumers
3. Determine Program Position within the Agency's Broader Goals
4. Define, Develop and Disseminate Guidelines for Consumer Involvement

Provide Additional Involvement Support to Consumers

1. Designate a Key Staff Position to Develop and Coordinate the Implementation of Consumer Involvement
2. Develop Resources (agency materials, budgets, information, etc.) in Understandable Language
3. Adequately Finance the Program (agency and consumer participation) at all Levels
4. Provide for Support Services such as Interpreters, Personal Care Attendants, Accessible Meeting Sites, Accessible Transportation, etc.

Foster Growth of Consumer Involvement

1. Encourage and Expand Agency Staff Participation in Consumer Involvement
2. Sanction Efforts for Staff to Get Involved in Consumer Activities
3. Implement Outcomes of Consumer Involvement Wherever Possible
4. Maintain a High Priority on Consumer Involvement Activity

Encourage Training in Consumer Involvement

1. Finance Training Program Skills to Improve Consumer Involvement
2. Explore New Training Methods for Outreach and Participation
3. Train Additional Persons (agency and consumers) in Consumer Involvement Skills

Publicize Consumer Involvement

1. Actively Disseminate Information within the Agency to Consumers and the General Public
2. Identify and Report on Results of Consumer Involvement

APPLICABILITY: The findings of this project will be of direct interest and benefit to disabled persons, state rehabilitation agencies, federal rehabilitation services administrators and others interested in consumer involvement programs. It will be useful for program planners, implementors and evaluators. Clients of rehabilitation agencies should find the information useful for understanding and participating in state rehabilitation agency activities.

122 A Follow-Up Study on Vocational Rehabilitation-Outcome of Patients Discharged from the Rehabilitation Institute

Principal Investigator:	**Martha Bernad, M.S.**	
Status:	**New/Continuing**	
Dates:	**November 1976-December 1977**	
Cost:	**Annual $11,645** **RT Annual $9,149**	**Projected Total $11,149 (RT)** **RT % of Annual Total 79%**
Annual Report Reference:	**#12, Page 111, R-63**	

OBJECTIVES: This study will examine and obtain answers to the following question:

What is the level of vocational activity of patients 18 months after discharge from a Rehabilitation Institute?

METHODOLOGY: The study, a collaborative effort of the Rehabilitation Institute and the Research Unit of the Massachusetts Rehabilitation Commission, will examine patients (18 months after discharge from the Rehabilitation Institute). The study population is drawn from the list of all patients discharged between January 1, 1975 and December 31, 1975. A questionnaire will be completed by telephone interview, since information sought does not require face to face interview.

Data Analyses: The questionnaire data will be coded and analyzed in conjunction with the functional assessment data (Barthel, Pulses). Pearson correlation will be used for analysis of functional assessment scores on Barthel, vocational functioning, and functional assessment scores on Pulses and vocational functioning.

Biserial correlation will be used to look at relationship of functional assessment Barthel score and contact with Massachusetts Rehabilitation Commission, and functional assessment Pulses score and Massachusetts Rehabilitation Commission contact. Biserial correlation will be used for analysis of functional assessment Barthel score and Pulses and contact with Rehabilitation Institute counselor.

Chi Square analysis will be used to determine if there is significant association between presence or absence of Massachusetts Rehabilitation Commission counselor contact and presence or absence of client satisfaction. Chi Square analysis will be used to determine if there is significant association between presence or absence of Rehabilitation Institute counselor contact and presence or absence of client satisfaction.

Chi Square analysis will be used to look at relationship between contact with Massachusetts Rehabilitation Commission and Rehabilitation Institute counselor.

FINDINGS TO DATE: Results have been obtained on 109 patients. Of these, 6 were deceased, 39 could not be contacted, and 74 completed the questionnaire.

Statistical analysis is being applied to data.

The vocational activity of the 74 patients questioned was the following:

Full-time Employed:	2
Part-time Employed:	3
Doing Household Work:	6
In School:	1
In Vocational Training:	17
Unemployed:	31
Other:	14

As can be observed, little less than half of the people questioned did return to gainful activity, while little more than 50% did not.

In observation it appears that Barthel scores are not good predictors of level of vocational activity. Pulses does appear to be a much better measure for this prediction. This data suggests that Pulses, which measures psychological functioning is a better predictor of potential vocational/educational outcome than Barthel, which measures physical functioning.

As can be seen to date, the major difficulties this group of patients has encountered which have kept them from returning to gainful activity are medical difficulties.

In examining contact with Massachusetts Rehabilitation Commission and Rehabilitation Institute vocational counselor after discharge, and patient's satisfaction with services received, the following results have been obtained:

MRC Contact:	21	Rehabilitation Institute Contact:	22
Satisfied:	15	Satisfied:	21
Not Satisfied:	6	Not Satisfied:	1

Qualification: As can be observed in the Massachusetts Rehabilitation Commission contacts, approximately 72% were satisfied, 28% were not; while 95% of people in contact with Rehabilitation Institute counselor were satisfied and 5% were not. It's notable that there is a higher percentage of satisfaction reported with the Rehabilitation Institute counselor. One explanation could be that the survey was done by a counselor from the Rehabilitation Institute (not the counselor with whom patients had contact). Biserial correlations are being applied to examine relationship between Barthel scores and Massachusetts Rehabilitation Commission contact; and Barthel scores and Rehabilitation Institute contact. Biserial correlations are also being applied to examine relationship between Pulses scores and Massachusetts Rehabilitation Commission contact; and Pulses scores and Rehabilitation Institute contact.

Chi Square analysis is being applied to see the relationship between contact with Massachusetts Rehabilitation Commission and the Rehabilitation Institute counselor. Upon observation it seems that approximately 50% of the Massachusetts Rehabilitation Commission counselors had contact with the Rehabilitation Institute counselor.

APPLICABILITY: The findings can be used by rehabilitation personnel in gaining an understanding of factors which influence vocational rehabilitation outcome.

123 Comparison of Outcomes of Obese Diabetics to Obese Non-Diabetics After a Multidisciplinary Program of Alteration of Preventive Health Behaviors

Principal Investigator:	**Theresa A. Hoskins, R.P.T., M.S.**	
Status:	**New/Continuing**	
Dates:	**July 1976-September 1980**	
Cost:	**Annual $14,311** **RT Annual $5,797**	**Projected Total $54,163 (RT)** **RT % of Annual Total 40%**
Annual Report Reference:	**#12, Page 309, R-65**	

OBJECTIVES:

1. To determine outcome differences between two groups of obese subjects: diabetics and non-diabetics, after a multidisciplinary program for the alteration of their preventive health behaviors.
2. To measure outcomes of all obese subjects involved in the multidisciplinary program, in terms of physiologic change (aerobic capacity), physical change (weight loss and body composition measures), metabolic change, (fat or carbohydrate substrate utilization), vocational or avocational change, and behavioral change (eating and activity behaviors).
3. To compare motivational factors in the two groups of obese subjects toward altering their preventive health behaviors.
4. To clarify the barriers, emotional or physical, which prohibit appropriate alteration of preventive health behaviors.

METHODOLOGY:

1. Screening of all obese subjects referred by physicians for a program of weight control was done on the basis of dietary history, body weight (20% over ideal), exercise tolerance, emotional suitability, and compliance with an individual diet over a preliminary four week period.
2. A written contract was written and signed by each person and each staff member.
3. Group behavior modification sessions were held once per week and group exercise sessions three times per week.
4. Behavior modification for weight control consisted of daily eating and activity records, the identification of eating cues, habits which encourage over-eating and factors in the social environment which lead to over-eating or under exercising. Elimination or substitution of maladaptive behaviors and environmental modifications were suggested. Relaxation techniques were taught. Videotaped simulation techniques were used to introduce issues confronting dieters.
5. Measures at the end of the contract period include changes in eating behavior, compliance with diet, weight loss, body composition changes, aerobic capacity, activity questionnaire.

FINDINGS TO DATE: To date there have been 20 completions, 36 drop outs, 7 incompletes and 15 enrollees. The overall drop out rate is 46%; the diabetic drop out rate is 16.7%.

Diabetic mean improvement in aerobic capacity is +.75 L/min O_2, while non-diabetic mean improvement is +.92 L/min O_2. Diabetic mean weight loss is -8.85 Kg, while non-diabetic mean weight loss is -4.32 Kg. Diabetic mean axillary girth measures were reduced by -1.875 inches, while non-diabetic mean girth reduction was -3.28 inches. Diabetic mean systolic blood pressure was changed by -9.4 mm Hg, non-diabetic mean systolic was changed by -2.3 mm Hg. Diabetic mean diastolic blood pressure was changed by -6.1 mm Hg, non-diabetic mean diastolic blood pressure was -2.4 mm Hg.

Follow-up on the 26% of the total population who completed the program successfully (50% of these are diabetics) show:

	DIABETIC CURRENT STATUS	NON-DIABETIC CURRENT STATUS
No further contact	2	5
exercising self	6	4
sought more help for weight	1	0
co-morbidity developed later	1	1
number employed	7	8

APPLICABILITY: The results of this study should provide information useful to other rehabilitation facilities and clinics where exercise can be made an integral part of an approach to treatment of obesity. Information about the problems diabetics have relative to those non-diabetics have in their efforts to lose weight have been relatively unavailable. These findings can be applied to a variety of settings.

124 Development, Testing and Application of a Phonologically-Based Communication System for the Non-Vocal

Principal Investigator:	**[illegible] Goodenough-Trepagnier, Ph.D./Linguistics**	
Status:	**New/Continuing**	
Dates:	**December 1977-December 1983**	
Cost:	**Annual $41,451** **RT Annual $38,633**	**Projected Total $215,545 (RT)** **RT % of Annual Total 93%**
Annual Report Reference:	**#12, Page 219, R-69**	

OBJECTIVES: The purpose of this research is to develop and test a language component for non-vocal communication which can be implemented with any type of hardware, which will have the following two features:

1. access to all of language: that is, the capability of producing any and all words of English,
2. maximum efficiency: that is, messages are produced by means of the smallest possible number of acts (pointing gestures, switch closures, etc.) per word.

METHODOLOGY:

1. Studies of the distribution in spoken English of sequences of phonemes. Phoneme sequences will be chosen for their frequency and combinability. Different algorithms to produce the ideal set of phoneme sequences will be compared for the "efficiency" of their result. Efficiency is defined as the number of unit (phoneme sequence) selections required per word to produce a test corpus.
2. Refinement of system, development of a simplified orthography. The system will be realized in pointing board and Etran formats. It will be tested with speaking subjects.
3. Selection and screening of non-vocal subjects. Subjects will be paired, based on similarity of scores in screening tests, age, and academic level. Development of training materials.
4. Training in system. Experimental Subjects will receive intensive training in this system, while control members of pairs will spend same amount of time in communication practice using their current communication mode.
5. After a 6 month period, language of all subjects will be reevaluated. Controls will then begin training in this system. After a second 6 month period language evaluation will again be carried out.

   Comparisons will be made between experimental and control subjects, and between pre and post-trained control subjects, in order to assess the effect of learning this system on language performance.
6. Messages produced by subjects in the course of training and practice with the system will be noted and analyzed. Error analysis will provide useful information both for adjusting the system and for improving the training techniques. Linguistic analysis of subjects' production will provide insight into productive language abilities of the non-vocal.
7. Comparisons will be made between non-vocal language development of speaking children.
8. The language data obtained from non-vocal subjects will provide the basis for development of materials designed to enhance language development and encourage language use.
9. Materials for communication enhancement in very young children will be devised, making use of the data obtained on non-vocal language acquisition.

FINDINGS TO DATE: A corpus of 250,000 words of spoken English, on computer tape has been obtained and transcribed into Webster's dictionary phonetic script by means of a Webster's dictionary on tape, plus numerous rules to handle inflected words.

An algorithm has been developed which selects units according to: (1) frequency, (2) left-to-right processing and (3) nonintersection. The resuting sets of units appear to provide efficient representation of English. However, efficiency remains to be measured.

An orthography which seems to be readily comprehensible by readers of English is being tested.

Other algorithms have been devised and await programmer and computer availability to be tested. Efficiency of the results of these procedures will be compared.

Arrangements are currently being made to begin selecting and screening subjects, and training methods are being devised.

APPLICABILITY: In the past, non-vocal individuals have often been diagnosed as cognitively and linguistically deficient, while it is possible and indeed likely that it is not native potential which they lack, but rather that non-vocal individuals, severely motorically involved, suffer from extreme experiential deprivation. Language acquisition requires exposure to the data of language and the ability to test unconscious hypotheses about grammar, including phonology, syntax and semantics, and communication. Cognitive maturation seems to require the same kind of access to the data of experience and the possibility of acting upon it - directly, by manipulation, or indirectly by language and thought experiments.

The motorically limited, mute child is deprived both in what aspects of the environment are available to him and in ways he can act upon it.

Early training in a non-restrictive and rapid communication mode should promote an increase in the amount and quality of language to which the non-vocal child is exposed, as well as giving him more opportunities to test his notions about language and the world. It will constitute an important step towards enriching the non-vocal child's environment and his possibilities of interacting with it and exerting control over it.

Participation in his environment, rather than passive observance of it, will have benefits for language and cognitive development, as well as the development of attitudes and behaviors that will enhance the non-vocal child's possibilities of realizing his human potential.

125 Integration of Independent Living into the Total Rehabilitation Process

Principal Investigator:	**Paul J. Corcoran, M.D.**	
Status:	**New/Continuing**	
Dates:	**November 1977-October 1980**	
Cost:	**Annual $72,322** **RT Annual $9,212**	**Projected Total $147,887 (RT)** **RT % of Annual Total 6.2%**
Annual Report Reference:	**#12, Page 281, R-71**	

OBJECTIVES:

1. To measure the effectiveness and costs of a transitional housing program designed to "deinstitutionalize" the later phases of medical rehabilitation.
2. To measure the effectiveness and costs of using independent living trainers (ILTs) as a new service to impart independent living skills not ordinarily provided by rehabilitation professionals.
3. To measure the effectiveness and costs of using an educational model in the medical rehabilitation process to foster greater patient responsibility in managing his/her disability.

METHODOLOGY: The study population consists of severly disabled persons served by the Tufts Rehabilitation Institute. Project effectiveness will be measured on the basis of goals and outcome criteria relevant to each of the project's three components -- transitional housing, independent living training, and education. The measurement of project effectiveness draws upon existing Institute expertise in the area of functional assessment but also considers refined measures of functional independence that captures behavioral changes in areas such as outdoor mobility. The research design uses a pre-post comparison of patients served by the project.

FINDINGS TO DATE: Core staffs have been organized to implement the project's key features and to test the project's feasibility in a medical rehabilitation environment. Experience to date has indicated a need to focus project services on selected disability groups in order to generate meaningful research conclusions.

APPLICABILITY: The project speaks to many issues in rehabilitation today. New ways are needed to minimize the dependency inducing features inherent in the medical model and in the institutionalization and professionalism accompanying current medical rehabilitation practice. The medical rehabilitation environment is an artificial environment that cannot accurately simulate the real world to which the patient must return and function independently. Moreover, the economics of health care delivery make it necessary for medical rehabilitation programs to locate and test alternative service strategies to minimize hospital lenghths-of-stay and costs.

126 Voluntary Control of Autonomic Functions by Spinal-Cord-Injured Persons: A Practical Application of Biofeedback in the Treatment of Hyperthermia and Postural Hypotension

Principal Investigator: Earl Gaddis, M.A.
Status: Continuing
Dates: November 1977-October 1979
Cost: Annual $35,955 — Projected Total $104,761 (RT)
RT Annual $33,062 — RT % of Annual Total 92%
Annual Report Reference: #12, Page 201, R-72

OBJECTIVES:

1. To determine the ability of spinal-cord-injured persons to voluntarily control such functions as blood pressure, skin and core temperature, and sweat production.
2. To identify factors useful to these patients in achieving such control: biofeedback, imagery, relaxation, autogenic exercises, internal and external incentives, classical conditioning.
3. To train spinal-cord-injured persons to use successful techniques under the stressful conditions of hyperthermia, postural hypotension, and hypertension associated with dysreflexia.

METHODOLOGY:

1. A thorough review of related research on learned voluntary control of autonomic functions was completed.
2. Questionnaires were sent to researchers and to spinal-cord-injured persons to assess the problems under investigation and to aid in experimental design.
3. Initial experiments on temperature and blood pressure control have been designed, utilizing biofeedback equipment (pulse-wave velocity, SPR and GSR, temperature feedback). Baseline measurements are being taken for each variable. Various techniques are being explored to determine their effectiveness in controlling these variables.
4. An experiment using iontophoresis with pilocarpine to stimulate sweat glands is being done with six quadriplegics and six normals as a control group. Quantitative sweat measurements are obtained by pre- and post-measurements of gauze and plastic wrapped over the area stimulated by pilocarpine. Areas stimulated include shins, forearms, and back of neck. The neck site represents a control for the quadriplegic as it is above the level of lesion, and one shin without the pilocarpine treatment serves as a control for both groups. Comparative measurements may indicate the intactness of the quadriplegics' sweat glands and will offer baseline material for the following experiment, which will measure the amount of sweat from the same areas under thermal stimulation. These experiments will give us an indication of how useful the conditioning of sweating could be in helping a spinal-cord-injured person control hyperthermia.
5. A pilot study will be designed and carried out after data is analyzed from the above experimental investigations. Quadriplegics will be trained to voluntarily control blood pressure and temperature utilizing those techniques proven most successful in the initial experiments.

FINDINGS TO DATE: Three normal and two quadriplegic subjects have been tested so far for sweating with iontophoresis. The instrumentation is still being worked out to complete this part of the project.

Interviews with quadriplegics, with injuries of more than eight years, indicated two types of patients. Some tolerate heat well and react poorly to the cold, while the reverse is true for others. Some patients have irregular sweating patterns such as sweating only on one side of the face. Postural hypotension does not appear to be a problem for these patients with long-term injuries. Major concerns are with blood pressure control preceding/during autonomic dysreflexia.

APPLICABILITY: With the results from this investigation, we will be able to define the areas in which specific experiments need to be done in order to develop a practical rehabilitation-oriented program. Such a program would train patients to successfully utilize these techniques as an additional aid to independence in daily living. The results of the present project will be useful to the growing number of clinical and rehabilitation facilities that are using biofeedback and related techniques to train patients to achieve voluntary control over autonomic functions.

127 Development of Training Curriculum for Consumer Trainers

Principal Investigator:	**Janet A. Minch, M.A.**	
Status:	**New**	
Dates:	**November 1977-October 1979**	
Cost:	**Annual $-0-** **RT Annual $-0-**	**Projected Total $61,198 (RT)** **RT % of Annual Total -0-**
Annual Report Reference:	**#13, R-70 (or contact principal investigator)**	

OBJECTIVES: The substantive problem to which we address this project is twofold: to prepare disabled leaders of consumer organizations to advocate effectively through **content** (what to say to business personnel) and **process** (how to achieve a positive impact in an efficient manner) so that businessmen will remove unnecessary barriers to disabled people in the community. The focus will be particularly upon businesses which offer products and services directly to individuals in a community, such as supermarkets, department stores, theaters, and sports recreation facilities.

1. To select where possible and prepare where necessary materials geared toward disabled individuals in the area of consumer education and consumer affairs. (separately funded)
2. To select where possible and prepare where necessary materials on effective techniques of encouraging action by persons in positions to effect change; in this case, business personnel.
3. To select where possible and prepare where necessary materials on laws, regulations, cost-benefit data, effective techniques and resources relating to barrier removal. (separately funded)
4. To prepare a curriculum for training disabled leaders and other disabled individuals in consumer education and consumer affairs. (separately funded)
5. To prepare a curriculum for training disabled leaders and other disabled individuals in effecting change.
6. To prepare a curriculum disabled persons can use in training business personnel in removing barriers to access by disabled individuals.
7. To train 60 disabled leaders in content and process, as a pilot.
8. To package the training materials and procedures for use in other locales through other RT Centers.
9. To tap the resources of RT Centers as regional instructional centers acting in concert to alleviate a serious rehabilitation problem.

METHODOLOGY: The proposed project will produce a set of high quality instructional materials. The materials will be designed by project staff and produced at RT-15 under the supervision of Joseph Moriarty, Project Director (RT-15). Mr. Schwartz, a media and materials specialist with private business background, will be responsible for drafting the materials and curricula, reviewing existing materials and curricula for possible adaptation or adoption, and determining an appropriate balance between project produced and currently existing resources. Sixty (60) disabled leaders selected from among officers and members of consumer organizations in Regions I and II will be invited to attend the two-day workshops to receive training and to provide the project with an opportunity to pilot test its materials and curricula. Evaluation, both objective and subjective, of and by participants, will be applied toward revision of project products prior to dissemination for the second year's activities.

We expect to produce the following kinds of materials:

1. Pre-workshop mailings acquainting participants with consumer education and consumer affairs;
2. self-instructional guides for participants to use in acquiring and reviewing techniques of effecting change in attitudes and actions of significant others;
3. slide shows and lectures accompanying the slides on barrier existence and removal;
4. pre- and post-tests;
5. participant evaluation forms;
6. post-workshop mailings on additional materials and issues.

Information from an Office of Education project will offer in-workshop materials on consumer education and rights as disabled citizens.

The procedures we will follow in the workshops stress participant involvement through active learning. We will structure role playing sessions on effecting attitude and action change among significant others, simulation training (to help participants understand and appreciate other disabilities and the barriers obstructing persons with these impairments), self-instructional readings, and small group sessions emphasizing participant involvement. Additionally, lectures and slide shows will be used.

By selecting participants from organizations of disabled people in the two regions, and by asking the organizations to nominate participants who will be held responsible for training members subsequent to the sessions, we are establishing the base for the trainees to become trainers. ACCD will supply additional sets of materials and resources for each trainee upon provision of documentation that he/she will teach a specified number of individuals in his/her organization.

The project will establish an advisory panel of eight individuals, at least two of whom will be from private enterprise, one from education and media, and four from organizations of and for disabled individuals. The advisory panel will review project plans prior to drafting of materials and curricula and again prior to actual production of final copies.

FINDINGS TO DATE: The program is still in the initial implementation stage and no findings or conclusions can be drawn yet.

APPLICABILITY: A major area for change from this project will be for the disabled consumers who are trained through the program and/or participate at a local level in activities stemming from the program. Some of these consumers will be clients of vocational rehabilitation. A model program of this type will provide a focus of activity for consumer organizations that take an active role in developing the program in their local communities. It should assist in organizing these groups who in turn can help to bring change to the accessibility of the business environments. It is anticipated that the practices of local businessmen through awareness and education, when regulations don't exist, will be responsive to making accessibility changes. These changes certainly are most important to the independent living needs and vocational goals of the vocational rehabilitation client.

Temple University (RT-8)
Medical Rehabilitation Research and Training Center

CORE AREA

Neurological and Neuromuscular Diseases

To advance practices and knowledge related to the rehabilitation of patients impaired by neurological and neuromuscular diseases through new initiatives for program activity such as participation in program development, execution and evaluation by handicapped persons themselves, and new concepts of impairment and disability such as the one developed by the World Health Organization.

TEMPLE UNIVERSITY

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

Multi-Electrode Studies of Patients with Spastic Central Nervous System Disorders (N. Mayer, M.D.) 128
Motor Unit Composition and Voluntary Force in Neuromuscluar Disease (A.W. Monster, Ph.D.) 129
Assessment of Driving Capabilities of the Brain Injured Population (W. Freedman, Ph.D.) 130

CONTINUING

Visual System Disorders and Functional Correlates (E. Kwatny, Ph.D.) 131
Development of a Model Demonstration Rehabilitation Service (Research Utilization Service) (N. Mayer, M.D.) 132
Computer Characterization of Patient Services (E. Kwatny, Ph.D.) 133
Clinical Classification and Functional Prediction: A Study of the Stroke Population (S. Bampton, B.S.) 134
Ambulatory Monitoring Laboratory for Rehabilitation Medicine (A.W. Monster, Ph.D.) 135

TERMINATING

Palatography and Delayed Auditory Feedback

Motor Control and Its Relationship to Functional Activities

PROPOSED

Observational Gait Analysis

Temple University

128 Multi-Electrode Studies of Patients with Spastic Central Nervous System Disorders

Principal Investigator: **N. Mayer, M.D.**
Status: **Completed**
Dates: **November 1974-October 1978**
Cost: **Annual $39,274** **Projected Total $117,882**
RT Annual $35,274 **RT % of Annual Total 90%**
Annual Report Reference: **#13, Page 16, R-141**

OBJECTIVES:

a. To record EMG firing patterns from multiple muscle sites during arm movement.
b. To describe spatial and temporal characteristics of the EMG patterns with respect to arm movement for the purpose of movement classification.
c. To describe movement patterns of patients with spastic central nervous system disorders.
d. To classify patients with spastic central nervous system disorders according to movement — EMG patterns.

METHODOLOGY: This project is directed toward studying the relationship between limb position i.e., movement, and electromyographic activity of several muscles. Specifically, the relationship under observation centers on the distribution of electromyographic activity during limb movement as a function of velocity.

By considering movement displacement and its associated integrated electromyographic activity (IEMG) as processess which go to 100%, we have been working on the derivation of a parameter which describes how the EMG distributes itself with respect to displacement as a function of movement velocity. Subjects are asked to move a pivoted rod forward at different self-generated rates and various amplitudes controlled for accuracy. Surface EMG from six muscles about the shoulder ("agonists," "antagonists," "synergists") are recorded and integrated during the course of the movement and displacement is measured by a potentiometer. Each movement is divided into a series of ten percent amplitude bins and the corresponding percentage accumulation of IEMG is identified by computers. By summing the differences between percent IEMG and percent displacement occurring at each 10 percent amplitude bin of the movement, a parameter termed the "delta parameter" is obtained which varies with velocity. If the IEMG level of activity peaks at 100% prior to the full extent of displacement, the delta parameter will be positive. Conversely, the delta parameter is negative when IEMG rises more slowly than the movement.

FINDINGS TO DATE: Results to date in normal subjects hsow that the delta parameter for anterior deltoid (an agonist in the movement studied) increases linearly with velocity at each movement amplitude while the slopes of the best fit lines vary inversely with amplitude. The delta parameter changed sign (from negative to positive) at different threshold velocities depending on movement amplitude. However, when average accelerations were calculated for each movement amplitude, the delta parameter changed sign at similar accelerations independent of differences in amplitude or velocity of movement. The delta parameter for posterior deltoid is generally negative in sign and appears to be recruited when anterior deltoid has a positive value only.

APPLICABILITY: These findings indicate that the distribution of IEMG with respect to movement displacement is quantitatively measurable and varies with movement speed and acceleration (for agonist muscles). Orchestration of central motoneuron drive according to the acceleration requirements of a given movement might be responsible for sign and magnitude changes in the delta parameter. It is suggested that a negative delta parameter for the agonist muscle might be a useful classifier of "slow" movements while positive values would be indicative of "fast" movements.

Patients with spastic central nervous system disorders (as well as central disorders with features other than spasticity) have clinically well known movement dysfunction. Movements ultimately depend on muscles and how the brain recruits these muscles for the task at hand. This study seeks to describe and classify movement dysfunction for a simple arm motion in order to identify motor control features which are retained or need to be retrained in patients with central nervous system disorders.

129 Motor Unit Composition and Voluntary Force in Neuromuscular Disease

Principal Investigator:	**A.W. Monster, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1975-October 1977**	
Cost:	**Annual $47,862** **RT Annual $47,862**	**Projected Total $95,724** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 47, R-144**	

OBJECTIVES:

a. To measure motor unit composition in a representative number of patients with neuromuscular disease of varying intensity and known etiology.

b. To compare the diagnostic outcome of a number of existing and proposed (electro) myographic procedures.

c. To describe, in functional terms, the pathological changes resulting from the disease process, including compensatory changes.

d. To determine under what pathological conditions the normal organizational principles of motor unit activation and of voluntary force production, are either maintained or re-established during recovery.

METHODOLOGY: The present methodology consists of three parts that are complementary to one another:

a. **Screening of Patients and Normal Individuals:** This consists of a general medical history, including neuromuscular status, ADL, voluntary motor coordination, sports activities, tremor, circulatory and metabolic disorders, routine use of drugs, emotional attitude, commonly perceived discomforts and general tolerance. The emphasis is placed on documenting the onset and time course of the neuromuscular disorder, severity of the disability as perceived by the patient, and the history of therapeutic trials, if any. A profile of each patient's residual motor power is documented on the basis of standardized tests.

b. **Motor Unit Composition:** The unit composition of a muscle is a measure of the force-producing potential of that muscle. Total number of units in the composition is quite stable over the normal adult age range. Our current methods of composition measurement are based on the highly systematic and mostly invariant way in which a muscle's motor unit pool is volitionally activated during a slowly increasing contraction. Due to this systematic motor response, observations on the behavior of a small representative number of units characterize the average behavior of units in a muscle's motor unit pool. These observations can thus be used to obtain composition estimates.

c. **Long-Term Studies on Muscle Usage:** The level of motor dysfunction of a muscle or muscle group in a patient with neuromuscular disease is directly related to the extent in which these muscles are required to produce force in order to perform normal functions. To evaluate this relative dependency, normal individuals and patients are instrumented with surface electrodes placed at one or more muscle groups. Muscle activity is recorded for long time periods. Computer analysis of this activity considers the average degree of usage and its relation to muscle fiber type, peak power requirements of different types of functions including appropriate vocational activity, synergy linkages among muscle groups, and changes in strength and endurance with physical exercise; especially limits to improvement and age-dependency of such limits. This data is correlated with the unit composition measurements.

FINDINGS TO DATE: During the first year, emphasis was placed on the following problems:

a. The ability of patients to tolerate the EMG motor unit composition procedure for a time period long enough to allow the examiner to sample a sufficient number of units. It was found that with a highly automated data logging method a total of 20 to 40 units could be sampled in less than one hour (10 patients). This number of units was sufficient for diagnostic purposes.

b. Recording of unit firing rates as a function of voluntary effort is relatively time-consuming. Knowledge of unit firing rate responses to changes in voluntary effort is required for obtaining a composition estimate. However, it was found that the number of units to be examined can be drastically reduced because of fairly consistent relationships that exist between a unit size and its firing behavior (based on a study of 180 simultaneously recorded unit pairs). Some sources of differential firing behavior are being examined further.

c. Unit size estimates based on EMG surface potentials are unreliable for large muscles. This is a result of the nonuniform distribution of the muscle fibers of specific units throughout the muscle cross-section. A prototype size-depth normalization method was developed for the tibialis anterior.

d. Recordings of normal usage patterns were made for 8 different muscles. A number of parameters characterizing usage have been developed as a normal data base.

During the second year emphasis was placed on: 1) clinically testing the present composition estimation method; and 2) comparing normal and abnormal usage patterns and their relationship to unit composition.

APPLICABILITY: Rehabilitation of voluntary motor functions depends on both adequate control of volition and on sufficient motor power. Whereas the problems of volition are complex and difficult to separate in identifiable component parts, the process of voluntary force production is definable in a functional-physiological sense. By diagnosing and describing the consequences of neuromuscular disease in functional terms, our understanding of the rehabilitation process is enhanced. The obtained findings lead to a clearer rationale for **therapy** in patients affected with these disorders. Significant **diagnostic** applications result from evaluative model of motor unit usage during voluntary muscle contraction.

130 Assessment of Driving Capabilities of the Brain Injured Population

Principal Investigator:	**W. Freedman, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1976-October 1977**	
Cost:	**Annual $52,308** **RT Annual $52,308**	**Projected Total $52,308** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 87, R-150**	

OBJECTIVES: The following goals are designed to be accomplished in sequential order:

a) Development of state-of-the-art paper on assessment of driving capabilities of the brain-injured population.

b) Identification of "need" for research based on specific biological and behavioral requirements gotten from the literature survey and from on-site visits to existing driver-assessment facilities.

c) A research plan to develop a process for assessing the driving capabilities of brain-injured people.

METHODOLOGY: In order to achieve the objectives of this proposal an extensive literature search was made in order to compile the information available concerning the brain-injured population. This included physiological-functional information so as to specify those parameters present in the driving environment which could affect driving performances of the brain-injured. Identification of vehicle dynamics under various road conditions was necessary, as was knowledge of driving tasks.

Included in the search was a review of the state and federal guidelines to determine the assessment procedures currently in use. This also required a compilation of the procedures of medical review boards in the various states. The state-of-the-art literature review was augmented with personal visits to selected facilities which have demonstrated expertise in driving simulation, psychological testing for driving capability, on-road instrumented assessment and treatment of brain-injured patients.

The population which this study consisted of were people who must contend with dysfunctions resulting from brain injury. Individuals exhibiting sequelae of the following etiologies were included: congenital lesions (e.g., cerebral palsy); acquired lesions (e.g., tumor, stroke); and degenerative lesions (e.g., cerebellar atrophy).

From an integration of the state-of-the-art with biological-functional information, a plan for further research will be recommended to develop a method to assess the driving capabilities of patients and to develop the interface between diagnosis of medical disability and assessment of functional performance in the tasks of driving.

FINDINGS TO DATE: This report is the beginning of a solution to the problem of assessing driving capabilities of the brain-injured population. The results were intended to provide a basis on which future studies could be built; it will be seen, however, that there is almost no information available in the literature. Compilation and summarization of literature were accomplished by computer and hand searches of all recently published material. The computer searches of data bases were completed using key word lists and expansion techniques. Primary sources which were searched are listed below with the years of coverage.

Source	**Period Covered**
Medline Index Medias	1965 - present
National Technical Information Service	1964 - present
Transportation Research Information Service	1965 - present
Science Citation Index	1974 - present
Psychological Abstracts	1967 - present
Social Scisearch	1972 - present
Compendex	1970 - present

The relevant bibliography and suggested research plan will be presented in the Annual Progress Report #14.

APPLICABILITY: It is clear that those brain-injured who are able should be provided the opportunity to operate a licensed vehicle. The questions are: how and who shall determine their driving capability? This project will attempt to suggest answers to these questions.

In addition to the independence and self-respect which is provided by mobility for the disabled, it also opens up the opportunity of self-support for the individual which benefits the individual and the taxpayer.

131 Visual System Disorders and Functional Correlates

Principal Investigator:	**E. Kwatny, Ph.D.**	
Status:	**Continuing**	
Dates:	**November 1975-October 1978**	
Cost:	**Annual $30,289** **RT Annual $38,289**	**Projected Total $90,867** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 28, R-143**	

OBJECTIVES: The purpose of this project is to provide a quantitative clinical physiological-functional analysis of certain visual system disorders. The disorders of interest are related to the inability to adequately position or maintain position of the eyes in order to provide sufficient visual information to the central nervous system. Specifically:

a. To establish a sequence of tests to objectively measure the function of the supranuclear control systems (participating in the control of eye movements) which integrate visual and non-visual stimuli to position the eyes so that basic and skilled functional activities may be accomplished.

b. To quantitatively evaluate functional activities such as visuo-motor skills and visual perception to determine the influence of visual system disorders on dysfunction.

c. To investigate new therapeutic approaches to modify visual behavior so that it is more appropriate to functional activities.

METHODOLOGY: **Population:** normal adult subjects (18-75 years of age); hemiplegic adults (18-75 years of age); adults with neurological disease with manifestation of ocular dysfunction (18-75 years of age).

Test Procedure: a) medical screening — a general medical history statement is taken from each subject with concentration on questions dealing with vision history, visuo-motor performance, ADL performance, and neuro-muscular status. Site of lesion, functional loss, current therapeutic program and visual system impairment is acquired from clinical notes and therapists. b) Clinical optometric examination — this examination includes ophthalmoscopy, analysis of near and far acuity and visual field analysis (central and peripheral), and an external examination (detection of phorias and tropias, motor field and motility examination, vergence and stereopsis testing). c) Visual system mechanisms — eye and head movements are examined during monocular and binocular viewing of a single spot stimulus in a 60 degree field. In order to evaluate the specific supra nuclear eye movement control systems, sequences of tests including several fixation, smooth pursuit and saccade generating tasks, are utilized. Saccadic and smooth pursuit tasks are performed with both the head restrained and unrestrained. This permits examination of the integrated actions of the vestibular and cerebellar systems in the control of eye movements. d) Visual perceptual and visuo-motor examinations: in order to examine functional visuo-motor activities of a subject, visuo-motor and visual perceptual tests are applied to assess whether a subject's visuo-motor activities are limited, and whether the source of these limitations are visual and/or motor. Visuo-motor activity is tested using an array of 25 lamps which are randomly lighted and are extinguished by having the subject touch the lighted position. Time and accuracy in acquiring the lighted stimulus are measured. Background illumination is varied (subdued lighting and total darkness) to permit examination of influences of visual and kinesthetic feedback on motor control. Visual perception, including form perception, form constancy, spatial relationships, visual memory and visual discrimination is examined using the Motor-Free Visual Perception Test (a non-motor and non-cognitive test). This test has been expanded to include the figures spatially reordered to the opposite side of the midline to evaluate visual neglect. An analysis of visual behavior during this test is accomplished by measuring horizontal and vertical eye movements during administration of the test.

Therapeutic Programs and Team Conferences: Team conferences have been implemented to discuss visual system dysfunction among all of the staff involved in testing of the patient. The objectives of these meetings are: (a) to integrate the results of all evaluations and relate the results to the patient's functional losses; (b) to determine needs for additional testing; (c) to define treatment objectives and course of treatment for the patient. Prescriptive therapy is carried out by either members of the project staff, or the patient's regular therapy staff. Therapists are trained to administer treatment programs that are unfamiliar to them. In order to determine effectiveness of treatment, pre- and post-treatment evaluations are carried out.

FINDINGS TO DATE:

1. **Visual Perceptual Performance:** The regular and "reversed" format of the Motor Free Visual Perceptual Test (MFVP) has been administered to 16 normal subjects. Time to respond for each item were also measured. The data indicate: (a) average scores are the same using the standard and "reversed" formats; (b) the composite score (right and left space) slightly increases the perceptual score. The increase is greater for subjects with low scores on both the standard and "reversed" tests; (c) the average score and response time decrease slightly with age; (d) the normal subjects respond equally well to the same figures whether they are right or left of midline.

   Seventeen patients have been given the regular and "reversed" format of the MFVPT. Patients scored lower and responded more slowly than age-related normals. Unilateral visual neglect is separated as a confounding issue by a preponderance of responses to one side when both formats are used. Pure perceptual deficit is identified by the variation in raw scores.

2. **Visuo-Motor Coordination:** In addition to total time for target acquisition and accuracy of response, time of initiation of hand movement is now measured during use of the visuomotor test board. Twenty-six normal subjects have been tested with dominant and non-dominant limbs and the three measured parameters are not significantly affected by age or limb used. Thus, it is assumed that patient responses would not be influenced by use of a non-dominant limb. Twenty brain-injured patients have been tested and they require nearly twice as long to reach the stimuli than normals (whether they have visual feedback of the limb movement or not). The data suggest that time of response is greater for patients in all test conditions, and the no feedback condition stresses the functional performance to better separate the two populations. It can be inferred from the data that these patients rely more heavily on using their vision to guide their motor performance and that in this group motor control is sub-normal. The visuo-motor test board has also been used to evaluate response to treatment and to better define therapeutic strategies.

3. **Visual System Mechanisms:** Patients with hemianopsia who exhibit functional visual neglect or do not have the awareness of their field loss were found not to respond to an instantaneous change of position of a spot stimulus into their blind field. There was no initiation of a search pattern of any kind. Other patients that have become aware of their restricted field will initiate a search for the stimulus. A characteristic searching movement is seen in this patient's small amplitude, small

intersaccadic intervals. Several hemianopic patients have been observed with smooth pursuit eye movements in the presence of a moving reference but at a velocity different from that of the reference (the physiological basis for this is unknown). Compensation for visual field loss is a necessary precursor to the acquisition of functional activities following cerebral insult. Various types of compensatory eye movements in hemianopsia have been observed. A patient with a diagnosed exclusive cerebellar lesion was examined. Oculomotor abnormalities of smooth pursuit and increased vestibulo-ocular excitability were observed in confirmation of the diagnosis.

4. **Evaluation of Oculomotor Activity during a perceptual task:** In order to define normative performance, 10 non-brain-injured subjects were tested with the MFVPT while eye-movements were monitored. The data reveal a great variability in individual performance, not only among subjects, but also with the same subject performing different tests. The particular sequence of eye fixations in the perceptual task appears to be an indicator of the procedure involved in information processing. These preliminary data indicate that there is a similarity in the sequence of the first three eye fixations. Variability after the third fixation may be due to past visual experience, type of visual task required, etc. Five brain-injured patients have been tested. The performance of the individuals patients was as variable as the normal sample. The fixation sequences differed (even in the first three fixations) than the normal group.

APPLICABILITY: Comprehensive rehabilitation programs must consider oculomotor and visual system disorders in view of their effect on the rehabilitation process. These disturbances often preclude the realization of valid ADL goals, such as dressing and grooming, as well as the achievement of balance and ambulation skills. Complete and accurate diagnosis is important in planning the most effective rehabilitation program for the patient. Most patients with perceptual motor deficits, for example, are entered into therapy programs following only a gross examination of visual and oculomotor function. Thus, it is assumed that visual input is good and treatment begins from there. This may not be the case at all; a need exists for diagnostic aids to separate visual and oculomotor dysfunction from perceptual dysfunction.

132 Development of a Model Demonstration Rehabilitation Service (Research Utilization Service)

Principal Investigator: **N. Mayer, M.D.**
Status: **Continuing**
Dates: **November 1975-October 1978**
Cost: **Annual $49,427** **Projected Total $148,281**
RT Annual $45,427 **RT % of Annual Total 92%**
Annual Report Reference: **#13, Page 57, R-147**

OBJECTIVES:

1. Examination of the transfer of research concepts, devices and training techniques to clinical practice areas in the large rehabilitation center.
2. Provision of an atmosphere to encourage academic and practical knowledge exchange between clinical and research personnel.
3. Provision of an inpatient environment nursing unit situation for use of devices such as environmental control and non-vocal communication devices.
4. Provision of a clinical setting for utilization of rehabilitation engineers.

METHODOLOGY: A ten bed inpatient service was established within the framework of a large rehabilitation center and adjacent to the clinical laboratories and engineering facilities of the Krusen Research Center. Patients who are admitted to this service may have specific clinical problems evaluated in the laboratories of the Krusen Center, and such information is then made available to the treating clinical therapists of the hospital. Individual programs for each patient are coordinated between the efforts of the clinical and research therapists under the direction of an attending physician. Weekly conferences are held to discuss the patient's progress in the program and to update or redesign various aspects of the program as necessary.

New concepts, devices and programs are initiated by research personnel in the Krusen Center and then demonstrated to and carried over by the treating clinical therapists. Coordination of conference schedules, patient activities, research and clinical input are the responsibility of the clinical coordinator for this program and all records and statistics are maintained by the clinical coordinator in the research center.

A rehabilitation engineer was recently added to the armamentarium of this service in order to facilitate the evaluation and adaptation of patients for environmental control systems, non-vocal communication aids and modifications or innovation in the area of sensory augmented feedback systems and other kinds of equipment. The engineer is brought into the clinical picture through the clinical staff and makes suggestions and designs which are recommended to the staff. Prescriptions are ultimately provided by the attending physician in consultation with the entire treating staff.

FINDINGS TO DATE: The routine evaluation of every patient by the multiple laboratories connected with the Krusen Center has been found to be generally nonproductive in the clinical sense. Patients are evaluated by individual laboratories, but it has been found more useful to evaluate particular problems that the patients have by those laboratories that can provide specific information which has immediate clinical relevance.

Evaluations based on clinical needs rather than routine multilaboratory evaluation, in a general way, have been most helpful. The availability of a clinical rehabilitation engineer who is specifically concerned with services for patients has proved to be of invaluable assistance in a very short period of time. Engineering input has increased the efficiency of obtaining, modifying, or developing devices to increase the functional capabilities of severely disabled patients. The presence of the clinical engineer has also relieved medical and allied health sciences personnel from the necessity of trying to solve problems that are not within their normal scope of practice.

Weekly conferences have been a consistent feature of this program. The aims of these conferences are to disseminate new concepts about devices and training techniques to the clinical staff and to the resident physician staff. Guest speakers have been invited and personnel from Krusen who have completed research in specific areas have made presentations to this audience. In general this function is publicized throughout the entire department of rehabilitation medicine and has been very well attended by a large number of clinical personnel of all backgrounds and training. Specific emphasis has been placed on updating the knowledge of resident physicians in rehabilitation with the long term view of influencing their rehabilitation practice.

Concepts of environmental control systems, functional electrical stimulation systems and non-vocal communication systems have been emphasized to this group as well as to the clinical staff as a whole.

Gait Journal Club has been added as a regular feature. Weekly clinical rounds, open to all RTC and hospital staff, are also held on the Model Demonstration Rehabilitation Service.

APPLICABILITY: Coordination of research and clinical teams in conjunction with clinical engineering services has provided increased efficiency in treating a population of severely disabled patients. It is noted that familiarity with newer devices such as functional electrical stimulation as well as environmental control systems has increased in the larger rehabilitation hospital setting since the advent of the service. In addition, a research utilization committee of the larger rehabilitation hospital has been functioning for more than 18 months and this committee is specifically charged with the screening and review of new devices and concepts for specific purchase for the hospital. It was also noted that rapport between clinical and research personnel has increased. There has been a freer exchange of both academic and practical ideas which have evolved during specific case management situations and has increased the efficacy of patient treatment. Staff has been more willing and eager to take on the challenge of some of the more severely handicapped patients who can be helped through external environmental control.

Discharge planning and coordination of inpatient activities with related community health service agencies such as the Bureau of Vocational Rehabilitation has been initiated at an earlier period and has resulted in smoother transition from hospital to home environment.

133 Computer Characteristics of Patient Services

Principal Investigator:	**E. Kwatny, Ph.D.**	
Status:	**Continuing**	
Dates:	**November 1975-October 1978**	
Cost:	**Annual $10,422** **RT Annual $10,442**	**Projected Total $31,326** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 66, R-148**	

OBJECTIVES: In order to characterize and evaluate patient services leading to functional recovery, a system must be developed to manage the abundance of information related to patient status and performance. The objectives, then are:

1. To develop a clinically oriented system for the management of clinical research data.
2. To develop a means to construct an appropriate data base of clinical and laboratory data.
3. To evaluate and demonstrate the system using the research utilization service.

METHODOLOGY: The technical staff (computer and information science) involved with this project will interact with the clinical and clinical research teams to better define the data relationships between testing and measurement and the data requirements for each set of evaluative tests. These data will then be used to define the structure of the data base maintained for patients undergoing evaluation and care in the rehabilitation service.

This system is to be used, principally, to help evaluate and establish relationships between clinical and research data. To do this, data collected and processed as a result of testing in the laboratory must be available to the clinician through the data management system. An organized set of data filing structures is to be constructed for storage of all data collected in the laboratories. The file structures will be hierarchical with test data saved in the lowest or most basic level, and data that have resulted from analysis, saved in higher levels. Through the use of a common storage structure with patient and data identifiers, a generalized data management system can be developed to manipulate all laboratory data within the Center.

A data base management system will be defined based upon current methodologies in this technology and using information gained from clinically oriented data base systems developed elsewhere.

FINDINGS TO DATE:

1. **Systems developed elsewhere:** Literature survey of developed systems revealed that the differences in application and purpose have resulted in very little commonality among clinically oriented data base management systems, especially for compatible hardware systems. A great deal of useful information is available concerning the methodology of specifying and utilizing data relationships. This includes specification of parameters related to the description and quantification of functional performance.
2. **Data Base Requirements:** Conferences with clinical staff and research therapists were held to examine and define data types and structures from which the data base would be constructed. The base level of the hierarchically structured laboratory data base, the "experiment data file" was defined and incorporated into all laboratories within the Center. The clinical data base management system will interface to this data file as well as higher level analysis files. The design of the clinical data base structure can now proceed in parallel with the continuing development of the research data base.
3. **Relationship to the Multi-User Computer System:** An analysis was made of the difficulties resulting from the implementation of this system within a multi-user computer system that also supports laboratory activities and other data processing. A serious problem is the very limited on-line rapid-access data storage facility. Only portions of a large data base can be available at any one time with the present equipment. The addition of a magnetic tape storage facility has eliminated problems related to storage of stable, archival records. Data transactions to the mass storage devices can excessively burden other data processing activities and laboratory data acquisition, because of the type of equipment available.
4. **Development of the Clinical Research Information Management System (CRIMS):** Although this system was designed around the specific requirements of the research utilization service, CRIMS' functionality is that of a generalized data management system. CRIMS is a set of computer programs and languages that acquire data, organize the data for storage, store and retrieve records, maintain data files, process user queries and other commands to the system, and transmit and display retrieved data. User commands are English acronyms, and CRIMS requires only that the user be familiar with the language of the data base management processor.

APPLICABILITY: In a program such as the Model Rehabilitation Service, the number of tests and therapy programs is increased to include new concepts and procedures, vast amounts of data become available for analysis of patient function. This system would provide a summarization of functional performance (and thus improvement). This would reflect on the relationship between therapy programs and the rate or level of recovery. Quantification of functional analysis is critical for objective evaluation of effectiveness and utilization of new rehabilitation concepts or procedures. This is true for evaluation procedures developed within and outside the Center.

The availability of all clinical data related to a particular patient assures the clinical research groups that they have all necessary information to evaluate the effects of other programs or therapy on the patients that they are treating. This is necessary to evaluate the efficacy and utility of a particular remediation program.

134 Clinical Classification and Functional Prediction: A Study of the Stroke Population

Principal Investigator:	**S. Bampton, B.S.**	
Status:	**Continuing**	
Dates:	**November 1975-October 1978**	
Cost:	**Annual $35,173** **RT Annual $35,173**	**Projected Total $105,519** **RT % of Annual Total 100%**
Annual Report Reference:	**#13 Page 75, R-149**	

OBJECTIVES: To develop an assessment and characterization methodology on the basis of findings presented by patients. The central concern of the methodology is the motor expression (performance) ability of patients having central nervous system disease.

METHODOLOGY: The methodology most simply described borrows from the Cronbach* expression, AXTI, where patient aptitudes are correlated with treatment interaction. Aptitude in this instance is to be regarded as any characteristic of the patient which interacts with treatment.

When reliability issues of the methods are satisfied, observations and correlations will be made among post stroke and other suitable neurologically disabled patients. These patients will be treated using functional electrical stimulation, for instance, and their summary characteristics will be reviewed in accordance with their outcome distribution.

FINDINGS TO DATE: The evaluation profile to be administered pre-therapeutically is being developed. Areas to be evaluated e.g. motor, sensory, have been defined and specific tests within each area are being collected or developed.

APPLICABILITY: A number of clinical-functional tests were developed that are being used by physical and occupational therapists in the Center to derive a summary description of an individual patient's status. This description has proved to be of value in pre- and post-therapy evaluations.

Among the number of tests, the observational gait analysis was selected for further development. This development centered on improving interrater reliability in order to enhance test objectivity and usefulness. Standard forms were developed to support the procedure and to score the observations.

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* Cronbach, L. J. Beyond the Two Disciplines of Scientific Psychology. In: Struening, E. L. and Guttentag, M. (eds) **Handbook of Evaluation Research,** Sage Publications, Beverly Hills, Calif., 1975.

135 Ambulatory Monitoring Laboratory for Rehabilitation Medicine

Principal Investigator:	**A.W. Monster, Ph.D.**	
Status:	**Continuing**	
Dates:	**November 1977-October 1980**	
Cost:	**Annual $61,234** **RT Annual $61,234**	**Projected Total $183,700** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 101, R-152**	

OBJECTIVES:

1. To demonstrate the routine clinical use of ambulatory monitors for a number of well defined assessment problems, (e.g., relation between physical activity and cardiac symptoms as observed in EKG).

2. To test the utility of a number of ambulatory transducer systems, recording systems, and analysis methods for a second (less well-defined) group of assessment problems (e.g., the description of the obligatory synergy response in stroke patients).
3. To develop a prototype ambulatory monitoring laboratory, organized as an evaluation service, for both inpatients and outpatients.

METHODOLOGY: The patient carries a miniature multi-(2-4) channel tape recorder on a waist belt. Commercially available recorder (Avionics, Medilog) are approximately the size of a desk calendar and weigh one to one and one half pounds. The recorder is connected to one or more transducers (e.g., electrodes, accelerometers, etc.) through signal conditioners placed within the recorder unit. The transducers monitor physiological variables such as muscular activity, the electrocardiogram, and biomechanical parameters. Interference with normal functional activities is minimal. Typically, a recording is continued for 8-24 hours, after which the tape is removed. The tape is then played back, on a separate tape scanner, at 25 to 60 times the recording speed. The computed data analysis is printed out on a high speed printer, using a standardized format. By maintaining a record or successive recording on one patient, as well as a library of normal reference data, comparative evaluations can be made.

FINDINGS TO DATE: The following was accomplished during the first year:

1. A diagnostic ECG scanner was developed for arrhythmia detection in 24 hour ECG tapes. A cooperative project was undertaken with Albert Einstein Medical Center Cardiology Department for patient referral and evaluation. The highly automated scanner can complete data reduction of 24 hour tapes of moderate arrhythmia activity in less than one hour. Results were presented at the Conference on "Computers in Cardiology," in September 1978.
2. Muscle activity patterns were studied in a number of functionally-linked muscle pairs in 12 normal males. A number of EMG parameters correlated significantly with muscle fiber type distribution. The average duration of contraction was directly related to the percent of Type I fibers (Science, Vol. 200, 21:314-317, 1978).
3. A scanning system was developed for evaluation of biofeedback therapy for postural stability training of cerebral palsy children. Data from 6 patients have been analyzed. The data have provided encouragement that ambulatory monitoring may place this type of long-term therapy on a more scientific evaluation basis.
4. A number of studies were undertaken to evaluate the utility of blood-oxygen transducers for ambulatory purposes. Different compromises will be examined in a followup study on a group of pulmonary rehabilitation patients.
5. Results from several of the above studies are being used in the development of a more general 4-channel cardiopulmonary scanning system to be used as an ambulatory monitoring prototype.

APPLICABILITY: The ulitmate goal of the rehabilitation process is to enable patients to perform at their highest attainable functional level. However, present evaluation methods rarely aim to establish whether this goal is reached during every day activities under diverse environmental conditions. Ambulatory monitoring provides a new and potentially powerful approach to problems of patient-status evaluation. This approach is highly cost-effective, as it is directed toward outpatients and non-hospitalization. New methods require effective and convincing demonstration before they can be integrated within the routine repertoire of clinical evaluation methods. This project is designed to demonstrate the contributions that an ambulatory monitoring laboratory can make to the rehabilitation process.

George Washington University (RT-9)
Medical Rehabilitation Research and Training Center

CORE AREA

Psychosocial, Vocational and Performance Capability Studies in Severe Disabilities

The rehabilitation outcome of the severely disabled which is dependent on the interrelated areas of psychosocial, vocational and performance capability factors.

THE GEORGE WASHINGTON UNIVERSITY

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

Family Factors in the Recurrence and Maintenance of Alcoholism and Other Chronic Disabilities (S.J. Wolin, M.D.) 136

Job Development and Enhanced Productivity for Severely Disabled Persons (Job Development Laboratory) (K. Mallik, M.S., M. Tech.) 137

Project Access (P.J. Verhoven, Re.D.) 138

A Pilot Project: Stroke in the Young (G.F. Molinari, M.D.) 139

CONTINUING

The Vocational Potential of ESRD Patients through Analysis of the Relationships between the Medical Factors of ESRD and Alternative Job Placement Strategies (Former Title: SR-9: Clinical Component: and SR-10: Vocational Component) (A.E. Parrish, M.D.) 140

The Role of Family in Institutional Rehabilitation of Clients with Behavioral and Physical Disabilities (D. Reiss, M.D.) 141

NEW

Post-Coronary Group/Exercise Therapy Study (Former Title: Rehabilitation of the Disabled Post-Myocardial Infarct Patient: Controlled Trial of Supervised Exercise vs. Group Counseling) (P.A. Gorman, M.D.) 142

Identification of Communication Deficits in Patients with Right Cerebral Hemisphere Damage (P.S. Myers, M.A., C.C.C.) 143

DISCONTINUED

Rehabilitation Potential of Stroke Patients as a Function of Cerebral Lesions, Visualized by Computerized Transaxial Tomography and Cerebral Blood Flow Patterns

136 Family Factors in the Recurrence and Maintenance of Alcoholism and Other Chronic Disabilties

Principal Investigator: Steven J. Wolin, M.D.
Status: Completed
Dates: July 1973-August 1977
Cost: Annual $57,126.46 Projected Total $250,000
RT Annual $7,806.14 RT % of Annual Total 14%
Annual Report Reference: #13, Page 34, R-37

OBJECTIVES: The objective of our initial study has been to distinguish two groups of families—those who transmit problem drinking and those who do not—based on a specific factor in the internal life of those families. The transmitter group of families is characterized by alcohol abuse in both parental and offspring generations; the non-transmitter families by such drinking only in the parent generation.

The factor under study is designated the "subsumptiveness of alcohol abuse rituals in family life." This is defined as the extent to which specific interactional behaviors (rituals) and family legends (myths) involving alcohol abuse have been incorporated, or **subsumed,** into normal patterns of daily life. In those families where incorporation has occurred we have hypothesized that a greater frequency of alcohol abuse transmission would occur into the children's generation than in those families where alcohol abuse remained distinctive, that is, outside the normal rituals and myths of the family.

The initial project has produced preliminary data which is very promising. Although our findings are thus far extrapolated from interview data reduction, it is clear that transmitter families are different from non-transmitters with regard to the interior life of the origin family, along the lines that we have suggested by the subsumption-distinctive variable. These tentative first findings, based upon the first nineteen families studied, show an unmistakable preponderance of ritual behavior around alcohol abuse during the children's growth years in the transmitter families distinguishing them as a group from the non-transmitter families.

Our objectives for the final year of this initial project have been fourfold:

1. Completion of interviewing of twenty-eight families using structured interview format.
2. Preparation of "blinded" dossiers of each family with information removed as to children's drinking behavior.
3. Development of a coding manual for the final ratings of family ritual in each life area and subsumptiveness of alcoholism.
4. Submission of an application for separate funding for a "second generation" alcoholism project which will further refine the two variables of subsumptiveness and family identity.

METHODOLOGY: In this section we will describe the proposed extension of this intergeneration Research technique, the Pilot Stroke Study Phase. We will review the anticipated subject population, instruments to be piloted for feasibility and appropriateness, and the likely methods of data analysis for the forthcoming work.

The new phase might well be labeled "An investigation of family barriers to the optimum rehabilitation of the stroke victim." The family factors under investigation can be divided into two categories – 1) factors which emerge from the family's **past history** and predetermine the patient's progress, and 2) factors which emerge from the family's **current interactional patterns** which provide a similar psychosocial barrier.

The study will collect data in these two areas using separate instruments. At their completion the data will be combined to provide a comprehensive and reliable assessment of the relations between the CVA patient and his/her family environment. As these psychosocial barriers are isolated and correlated with actual rehabilitation efforts high risk families will benefit from the specific family focus provided by our approach.

The total usable interviews completed and reported in Annual Progress Report #13 were:

Fathers	26
Mothers	26
Children	63
	115 x 2 = 230

FINDINGS TO DATE:

1. **Coding Manual and Rating Procedures:** Preparation of instructions for the blinded rating procedure was a major task during FY1978. The final Manual and Rating Form for data analysis are completed.
2. **Finding and Final Report:** Blinded rater codings were completed as of 9/1/77 on all families. Reduction and analysis of data is underway and scheduled for completion by December 1977. A final report will be forthcoming.
3. **Initiation of Further Work on Alcoholism Transmission:** We have observed that the selection of a particular spouse, combined with the nature of the origin family environment are two factors which relate to the development of alcohol abuse in adulthood. This second variable we have termed the **selection of a family identity.** To study these two variables further we have received funds from the National Institute on Alcohol Abuse and Alcoholism for work which will examine families with married children who have an alcoholic parent in an attempt to predict the children at high and low risk based upon origin family type and spouse selection.

APPLICABILITY: This work has a special applicability and relevance to the rehabilitation of the **chronically** alcoholic family, i.e., the family repeating patterns which will support and maintain problem drinking over generations. Rehabilitation in this instance becomes intertwined with prevention since the interruption of patterns of transmission will **rehabilitate** the current nuclear family while it **prevents** future generation's disability. To achieve this goal, however, this work requires considerable refinement: validation of the basic concepts of ritual, subsumptiveness and family identity through additional studies, such as our "within family" study beginning 9/77; and use of these concepts in techniques of intervention, principally family therapy. We look forward to these results as long-term objectives, highly relevant in alcoholism rehabilitation.

137 Job Development and Enhanced Productivity for Severely Disabled Persons (Job Development Laboratory)

Principal Investigator:	**Kalisankar Mallik, M.S., M. Tech.**	
Status:	**Completed**	
Dates:	**September 1974-February 1978**	
Cost:	**Annual $83,444.13** **RT Annual $63,888.58**	**Projected Total $360,000** **RT % of Annual Total 76%**
Annual Report Reference:	**#13, Page 124, SR-2 (R-41)**	

OBJECTIVES:

1. To increase employment and placement of severely handicapped persons by increasing their capacity to perform a wider range of those physical tasks ordinarily associated with information handling jobs;
2. To reduce barriers to employment, lateral and upward mobility, and training for more appropriate and satisfying work, and to reduce the costly restructuring of jobs for the severely disabled;
3. To improve and increase through low-cost technological methodology the productivity, versatility, and adaptability of severely disabled persons presently employed in information jobs or in jobs where information handling is a critical subtask;

4. To insure and enhance job stability by increasing productivity and thereby, to gain a better return of the original rehabilitation investment dollar;
5. To list the job tasks uncovered and to describe their solutions in cost/benefit terms so that general applications can be made to jobs and job groups;
6. To demonstrate the utilization of the project's results through their application to federal government agencies;
7. To advance presently employed severely disabled persons along the employment ladder and to open up jobs in private industry and government.

METHODOLOGY: Following the selection of severely disabled clients, jobs will be selected, developed, and analyzed for the clients. All clients will be evaluated to determine their functional, psychological, and cognitive abilities. Clients and jobs will then be matched and, as necessary, modifications and adaptations in the job and work situation will be made through bioengineering. This will involve the prescription, design, construction, and fitting of adaptive aids and environmental modifications. The productivity of the workers will be analyzed and a cost/benefit study carried out; following this a final report will be released.

FINDINGS TO DATE: Through research and the development of an innovative on-site and homebound placement model, the project has demonstrated the competitive and job productivity capacities of severely disabled persons who, otherwise, are considered infeasible for conventional rehabilitation by state departments of vocational rehabilitation.

Findings indicate conclusively that:

1. Information handling jobs are well suited for a severely disabled population.
2. Low cost technology can enhance the capacity of severely disabled persons to perform tasks associated with information handling jobs.
3. A multidisciplinary team approach towards placement of the severely disabled will result in increased quality employment of severely disabled persons.

APPLICABILITY: The research findings indicate that rehabilitation money invested in the job placement process for severely disabled persons are cost-effective and result in competitive earnings for clients and job stability. The project's outcome should influence change of employer's attitudes towards hiring severely disabled persons.

Rehabilitation facilities can utilize these techniques (jobs development, job training, client analysis, job-client matching, job tasks modifications and job re-engineering) to place severely disabled clients. Potential employers can utilize many of these resources to implement the Affirmative Action Program for hiring the disabled.

138 Project Access

Principal Investigator:	**Peter J. Verhoven, Re.D.**	
Status:	**Completed**	
Dates:	**September 1974-February 1978**	
Cost:	**Annual $128,492.01** **RT Annual $128,492.01**	**Projected Total $200,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 174, SR-6**	

OBJECTIVES:

1. To establish and demonstrate the effectiveness of an accessibility advocacy within the structure of a city/space VR agency, with the function of representing the accessibility interests of the VR client to both government and private sectors.
2. To determine and demonstrate with actual building(s) and transportation systems, realistic, low cost approaches to utilizing accessibility technology which can be drawn from existing city resources.
3. To develop and establish ongoing consumer input mechanism providing a consumer voice on accessibility issues.
4. To develop and establish a community resource supported, continuous mechanism of identifying accessible buildings and transportation systems.
5. To develop a realistic, long-range city-wide accessibility strategy and implementation plan.

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6. To document processes and results of the advocacy for dissemination to other VR agencies for possible adoption into the existing agency structures.

METHODOLOGY: Within the goals and scope of Project Access, the Department of Human Resources of the District of Columbia Government serves as subcontractor to RT-9. A staff of three is proposed to consist of a Project Coordinator, Architectural Specialist, and an Administrative Assistant to provide full time presence and technical authority to deal with accessibility problems. The accessibility advocacy will be located under the direct administrative control of the Chief of the Bureau of Rehab. Services with operational responsibilities to the Mayor's Committee on the Handicapped.

Selected building sites will be identified and modified to serve as live models for what can be accomplished. Emphasis on this demonstration will be placed on selection of areas where relatively simple, low-cost modifications will result in accessibility. Impact studies will be conducted to assess the vocational employment impact of the modifications. This data will be utilized in developing cost benefit rationale for barrier removal.

A transportation accessibility project(s) will also be initiated to demonstrate the utility and cost benefit of existing system adjustments. Impact studies will also be conducted. Selection of these target projects will be based on their visibility and potential to enhance vocational opportunities.

Using existing disabled consumer organizational structures, the accessibility advocate will attempt to develop a formalized linkage between consumer and the city government by creating a permanent, executive level forum through which the disabled themselves can function as a monitoring group.

A printing of a revised, second edition of the guidebook, **Access Washington,** is planned. Since this kind of book is in need of constant updating, an attempt will be made to develop an ongoing mechanism for advising the community of accessible facilities. The accessibility advocate will develop a comprehensive, realistic long-range plan for accessibility in the city which will serve to prioritize actual projects so that areas with the greatest potential impact are addressed first. The plan should also serve as a coordinating vehicle to prevent counter-productive activity.

Project progress and continuity will be monitored by a select committee chosen by the Chief of Special Centers, RSA, and chaired by him. The committee will meet at least quarterly to review progress and evaluate performance. A formal written interim progress report will be delivered at each meeting for review by the committee.

FINDINGS TO DATE: The guidebook, **Access Washington,** was published in February, 1976. The initial printing amounted to 10,000 copies, of which nearly all have been distributed. Plans are being formulated for a revised second edition and a printing of another 10,000 copies.

Project staff designed and produced a brochure to create visibility for the project and availability of resources, expertise and technical assistance to individuals, consumer groups and federal agencies interested in environmental free architecture and assistance in hiring the handicapped.

Due to difficulties in hiring staff for the District of Columbia Government subcontract, Project Access was inactive during part of Fiscal 1976 and during part of Fiscal 1977. Staffing was completed and the project reactivated, effective 3/01/77.

The completion date for this project will be February 28, 1978. At its conclusion the project will have produced the following deliverables:

a. A systems model for increasing employment for the physically handicapped through the elimination of architectural barriers.

b. A system for planning and implementing specialized transportation services to handicapped clients.

c. A guidebook on the status of accessibility of a variety of facilities and buildings for the physically handicapped.

d. A publication, in tabloid, for handicapped consumers and advocacy groups to assist in employment opportunities through the removal of architectural barriers.

APPLICABILITY: Success in vocational rehabilitation can often be denied through lack of accessibility. The problem of accessibility is well recognized and documented in the rehabilitation community. For the District of Columbia Bureau of Rehab. Services, it is a crucial issue. This project will attempt to address the social, economic, attitudinal and legal barriers that inhibit the implementation of accessibility in the District of Columbia.

Vocational, social and psychological rehabilitation will be enhanced and hastened if the primary goals of this project can be achieved. The identification and removal of architectural barriers along with availability of a comprehensive guide to accessible facilities will open new horizons for persons formerly restricted in their activities.

139 A Pilot Project: Stroke in the Young

Principal Investigator:	**G.F. Molinari, M.D.**	
Status:	**Completed**	
Dates:	**December 1976-January 1978**	
Cost:	**Annual $67,121.16** **RT Annual $53,881.48**	**Projected Total $81,364** **RT % of Annual Total 80%**
Annual Report Reference:	**#13, Page 185, SR-8**	

OBJECTIVES:

1. Identify objective anatomical, physiological, and neuropsychological variables contributing to the vocational and rehabilitative potential in younger stroke patients.
2. Determine the validity and reliability of the EMI scan, the cortical evoked response, and classical standardized aphasia testing, and quantitative psychological assessments as indicators of the anatomical, physiological, and psychological substrates of vocational rehabilitation.
3. Develop a protocol using the most sensitive, reproducible, and reliable of these parameters for a standard evaluation procedure and progress monitoring tool for rehabilitation programs targeted at vocational and avocational independence.
4. Disseminate the information accumulated in this pilot project on the utility of these "state of the art" parameters in assessment of vocational rehabilitation by offering a seminar on "Anatomical, Physiological, and Psychological Substrates of Vocational Rehabilitation."
5. Publication of a monograph targeted at vocational counselors indicating the utility, desirability, and availability of these parameters in assessment of prognosis and eventual outcome of rehabilitation of the younger stroke patient.

METHODOLOGY:

1. Data gathered will include (a) basic clinical variables for identification of site and size of neurological insult, including all the clinical signs and symptoms reputed to have prognostic or diagnostic value, and (b) EMI scans, electrophysiological studies (cortical evoked response), speech evaluations or neuropsychological tests as indicated clinically. Test parameters will be collated with clinical signs and symptoms at at least three points in the natural history of each patient's illness: initially, at three months, and at six months.
2. Each patient will have presenting signs and symptoms recorded. An initial EMI scan is routinely performed on all stroke patients entering the G.W.U. Comprehensive Stroke Care program. This has now become a "state of the art" diagnostic service for such stroke patients, and although data obtained from the initial EMI scan may be used in the study, its primary purpose is patient service and is not to be purchased by the research program. A repeat EMI scan will be obtained at three months, which will be obtained for investigational purposes and should be at no expense to the patient. The EMI scan at three months, based on our previous work on this study, will accurately represent the residual lesion itself and is reciprocal, the anatomical substrate for rehabilitation.
3. Cortical evoked responses already in research development, sponsored by the Rehabilitation Research and Training Center, will be at no expense to the patient.
4. In right hemiplegic patients initial evaluation by speech pathologists will be obtained at a point in the course of the illness if and when clinically indicated, and will be considered a patient service to be used in initial diagnosis. Similarly, in left hemiplegic patients, neuropsychological testing, including the specific tests for nondominant hemisphere functioning, will be obtained for diagnostic purposes as a service to patients. Both types of neuropsychological evaluation will be obtained in any individual patient only if there is evidence of bilateral lesions or a history of a previous stroke. However, as an investigational parameter, either the comprehensive speech evaluation or the psychological testing will be repeated at six months for correlation with performance in the vocational rehabilitation program and for correlation with the anatomical and physiological variables obtained earlier in the course.
5. Patients referred from other hospitals directly to the rehabilitative program late in the course of their illness as outpatients will have one each of the following test parameters: (a) EMI scan (if not previously performed and available), (b) auditory/visual and/or somatosensory cortical evoked

response, and (c) either speech and language evaluation or comprehensive psychological testing.

6. Based on our analysis of demography in the first nine months of operation of the project "Prognostic Value of Computerized Axialized Tomography in Stroke Patients" a minimum number of thirty patients under the age of 55 will be comprehensively evaluated during this one year project.
7. Based on analysis of the data obtained on these thirty patients in this pilot project, the provisional protocol will be reviewed, the reliability and validity of individual test parameters will be reassessed, and a standard protocol will be developed for trial as a standard clinical tool for quantitative assessment of the anatomical, physiological and psychological substrates of vocational training in younger stroke victims for use in the G.W.U. Rehabilitation Research and Training program and other affiliated comprehensive rehabilitation programs.
8. As little vocational and avocational application of stroke research is presently utilized, and these areas are particularly important to stroke in the young, the Job Development Laboratory's involvement will be directed at this level of stroke rehabilitation. In conjunction with therapy and testing most sensitive and applicable to employability of stroke patients (i.e. speech therapy, activities of daily living, occupational therapy, physical therapy, computerized axial tomography, cortical evoked response, classical standardized aphasia testing, and quantitative psychological assessments). Laboratory staff will utilize supplementary testing to complete the vocational profile. These tests may include perceptual and functional evaluations and pre-vocational testing as necessary. This testing and evaluation battery will be performed with approximately twenty young medically-stable stroke patients through medical referral.

   Integration of medical, therapeutic, and vocational tests, as well as the development of Criteria for interpretation of evaluated results, will form the basis for a quantitative employability system to evaluate client vocational potential.

   Drawing upon the Job Development Laboratory's experiences in the areas of job development, job-task analysis, and job-client matching, target vocational areas will be analyzed relative to levels of cognitive and physical functioning.

   Through correlation of Job Task Analysis and Client Functional Levels, some areas of functional adaptation may be indicated. These may include testing equipment as well as functional aids.

   Subsequent to this first year of research, implementation utilizing the quantitative employability system in a vocational placement setting will be demonstrated contingent on future findings.

FINDINGS TO DATE: **Clincal Component:** Ten months of data collection produced annualized accession dates of 23 cases/year from the Neurology Consultation Service and another 24 cases/year admitted directly for neurological care, all 47 of whom met the arbitrary criterion of age 55 or less. If the definition of "stroke in the young" were to be liberalized to "stroke among the actively employed and homemakers" independent of age, the number would double to approximately 100 patients/year. Another bias identified which reduced the number meeting the extant age criterion was the fact that only three cases of subarachnoid hemorrhage in young persons were brought to the attention of the investigators; since this diagnosis is usually made in the emergency room by prompt CAT-scan evaluation prior to lumbar puncture, patients in whom this common cause of stroke in the young is diagnosed are admitted directly for neurosurgical treatment.

The characteristics of the patient population were as follows: two patients with occlusive cerebrovascular lesions were under age 20; both were males. The predicted cluster of thromboembolic strokes in women taking contraceptive hormones, was observed (approximately 25% of cases). Hypertensive intraparenchymal hemmorrhages in young Blacks of both sexes accounted for 35% of cases with Black males having a slightly higher incidence than females. Suspected illicit substance abuse occurred only twice, both in males, one Caucasian and one Black. The remainder, (approximately 35%) constituted a pot-pourri of etiologies including rheumatic heart disease, artherosclerotic heart disease, spontaneous brain hemorrhages in younger hypertensive whites of either sex, and a large population of thromboembolic phenomena in persons in whom no etiology could be found. Absolute numbers of instances in each category are small (total number 47) and therefore percentages tend to mislead because they inflate very small cells in the data. Trends only are considered reliable, however, and despite the conspicuously low incidence of illicit drug abusers estimates made by retrospective analysis one year ago are confirmed.

In general, functional recovery after stroke was spontaneous and to a high level in most patients in the age group under 55.

CAT scans showed a preponderance of lesions in subcortical structures of the brain. Both ischemic and hemorrhagic lesions generally spared cortex except in very evident cases of embolism from primary disease of the heart. Nonetheless, aphasia was an early transient symptom and sign in most patients with left hemisphere lesions, but CAT scan localization indicated a deep vascular territory of involvement.

Despite comprehensive medical evaluations in each case, approximately 25% of young stroke patients have no detectable etiology for their disease.

Psychosocial Component

a. Rewards in stroke favor those who remain "sick" as with certain other chronic diseases. Specific examples encountered during this project include:
   - Contemplation of an actual prosecution of malpractice litigation
   - Premorbid job dissatisfaction; illness presents possible option of medical disability retirement
   - Reactive depression

b. Younger patients often utilize **DENIAL** as major defense mechanism. Reinforced by spontaneous and high quality recovery, many unconsciously or consciously ignore the high risk category in which first stroke places them.

c. Physician insecurity in cases in which diagnosis is unknown. Patients are often preoccupied with uncertainty of prognosis for recurrence. Accurate diagnosis is required for formulating appropriate plans for **Tertiary Prevention,** specifically, prevention of recurrence. Patients confronted with their own vulnerability by premature illness may seek second opinions; if no clearer prospectus is forthcoming from health care delivery system, patients may then resort to despondency and depression, or conversely, to **DENIAL.**

d. Numerous anecdotal examples may be cited of life-crises, developing or extant in the pre-morbid stage of illness in stroke patients. Examples from our own prospective data include: (1) imminent dissolution of family in a 15 year old boy who developed stroke after accidental blow to the neck during a soccer game, at a time when the parents were contemplating divorce; (2) right hemiplegia and transient aphasia in a 42 year old woman in the process of divorce who discovered a lump in the breast which was proven to be malignant. Ischemic cerebral lesion was related to an ulcerated plaque in the carotid artery in the neck and was proven to have no direct medical relation to the recently discovered cancer (subsequently successfully treated).

Vocational Component

1. Protocol for a functional vocational evaluation for post-stroke patients has been developed, including a base data form and problem-oriented recording procedure. The Functional Limitation Inventory was selected as the instrument to determine whether or not a subject's vocational prognosis has improved as the result of the research staff's intervention.

2. Of the nine persons who have agreed to participate in the study, six have been rated on the Functional Limitation Inventory. Of these six, a comprehensive evaluation has been completed strategies planned for vocational improvement. Intervention strategies used thus far range from selective residual skill/job matching (including Human Performance Laboratory tread-mill testing to demonstrate to an employer the post-CVA exertional capability of one subject), job analysis, retraining for maximum use of residual capacity, job development, to supportive rehabilitation counseling.

3. Vocational progress for some project participants has consisted of:
   a. One individual has returned to work through the efforts of the research staff.
   b. Another participant, severely disabled by stroke and out of work for seven years, is undergoing one-handed typing training and drivers education in preparation for returning to work.
   c. A third individual, out of work for four years, has received educational, job and drivers training as well as job readiness counseling to eliminate undesirable interviewing behaviors and attitudes.

APPLICABILITY: To summarize, the findings are expected to provide state agency rehabilitation counselors (as well as other placement interested personnel) with a means to vocationally assess, plan, counsel and place individuals who are severely handicapped with stroke disability. It will establish the value and methods for reducing the handicapping impact of stroke disability through aforementioned techniques such as job modification and client-job matching. Furthermore, a process not only for functional assessment and for identifying counseling issues, but also for training counselors in work with stroke-disabled persons will be established. All of these factors will provide the means for state agencies to comply with legislative mandates and better serve the severely handicapped population.

While this project applies approaches long utilized by physical rehabilitation to the vocational rehabilitation of this disability group, it will impact on service delivery by establishing the need for specialists in job modification and redesign to be included in the service delivery system for this group.

The results of this study will also:

a. provide an improved understanding of stroke in the work-age population;

b. demonstrate methods to reduce functional deficits;

c. test the application to a stroke-disabled population of a research instrument for appraising vocational diagnosis and for identifying counseling issues;

d. devise and test a problem-solving protocol for appraising and enhancing vocational prognosis and for managing the vocational rehabilitation of stroke patients; and

e. training area rehabilitation counselors in vocational rehabilitation planning, management, and intervention for the young person disabled by stroke.

This research is, finally, expected to result in increased training and placement opportunities for individuals disabled by stroke, as well as to provide the means for training rehabilitation counselors to work more effectively with this disability group.

140 The Vocational Potential of ESRD Patients Through Analysis of the Relationships Between the Medical Factors of ESRD and Alternative Job Placement Strategies (Former Title: SR-9: Clinical Component: and SR-10: Vocational Component)

Principal Investigator:	**Alvin E. Parrish, M.D.**	
Status:	**Continuing**	
Dates:	**December 1976-January 1979**	
Cost:	**Annual $56,530.68** **RT Annual $43,123.21**	**Projected Total $105,746** **RT % of Annual Total 76%**
Annual Report Reference:	**#13, Page 216, SR-9**	

OBJECTIVES:

This project proposes to accomplish the following objectives:

1. To develop an understanding between:
   The primary disease producing End-Stage Renal Disease.
   Medical complications associated with hemodialysis.
   Work tolerance of patients undergoing chronic hemodialysis.
   Impact of dialyzing schedules and vocational potential.
2. To produce, based on the findings in Objective 1, a protocol for assessing vocational potentials of ESRD clients including strategies for:
   Restructuring clinical procedures and dialyzing schedules to minimize negative vocational impacts.
   Job restructuring and modification to accommodate reduced work tolerance and dialysis scheduling problems.
   Job retraining into vocational fields most suited to the ESRD client population.
3. To conduct a region-wide conference to disseminate project findings to vocational rehabilitation counselors and ESRD clinical personnel.

METHODOLOGY: A group of clients with End-Stage Renal Disease will be studied so that factors such as medical complications (type and frequency) and physiological performance capability can be examined in relation to type of work experiences, loss of time from work, setting of dialysis, family support and complicating disease.

In the assessment of performance capability, nerve conduction time in the leg will be measured using a model TEC 6M electromyograph and exercise testing will be used consisting of 10 minute walking at 2.5 miles per hour at no grade to determine the ability of the client to exert minimal activity. Concomitantly, changes in serum potassium, lactate pyruvate, blood pH, blood pressure and respiratory rate will be monitored.

Areas in which vocational project staff will concentrate are:

1. Selection of realistic vocational objectives according to physical and cognitive functions;
2. Development of short term training programs commensurate with actual employment opportunities;
3. Initiation of group sessions for clients and family members to promote work motivation;
4. Work site environment modification;
5. Job restructuring; and
6. Treatment regimens and dialysis schedules.

FINDINGS TO DATE: **Medical and Performance Capability Assessment** A survey was begun in December 1976, of patients at the Dupont Circle Dialysis Center, relating to their dialysis complications and ability to return to work. Beginning in July 1977, physical studies were begun using the exercise test to determine patient's ability to exercise for a standard period of time. The selection of patients was made at Dupont Circle Dialysis Unit, using those individuals who physically appeared capable of undergoing the exercise test and who volunteered to take part. The procedure was as follows: on the morning prior to dialysis the patient had baseline determinations of blood pressure, pulse, respiration, lactic acid, lactate pyruvate, potassium and blood pH. Each individual was then exercised on a treadmill, walking for 10 minutes at 2.5 miles per hour at no grade. At the end of the exercise, the baseline tests were repeated again, in 10 and 20 minutes, post exercise. To date, six normal individuals and seven patients with End-Stage Renal Disease have been studied. The maximum change in the values observed are shown in Table 1. The most significant changes occurred in serum lactate levels and in this group of studies, 4 out of 7 patients with End-Stage Renal Disease, showed a maximum increase in serum lactate exceeding two times the standard deviation of normal individuals. In all four of these individuals symptoms developed during the test which in two, precluded the completion of ten minutes of exercise. Symptoms consisted of weakness and fatigue in the legs. These individuals also showed an increase in potassium and in one individual, a decrease in blood pH.

It would appear from these preliminary findings that individuals undergoing maintenance hemodialysis do have physical disabilities as manifested by their inability to exercise at a minimal rate, and that this inability may be related to their failure to return to an active life. Two possibilities as to the cause may be postulated: (1) that there is inadequate dialysis, resulting in abnormal carbohydrate metabolism, since it is already known that individuals with renal failure develop carbohydrate intolerance with elevations in serum and blood sugars and abnormal glucose tolerance tests, and since it has been shown in animals that this appears to be a block in either cyclic AMP or ATP. It is possible that an inability to develop aerobic metabolism in the Kreb's cycle could account for the rise in serum lactate; and (2) that these individuals are physically in such poor condition that they are unable to carry out the exercises. It is proposed, therefore, that when sufficient data is obtained, that two additional groups will be studied, made up of those individuals who show an increase in serum lactate greater than twice the standard deviation of normal in individuals. One of these groups will have increased dialysis time; the other group will undergo standard exercises to increase their physical fitness. After a period of time (4-6 weeks) the tests will be repeated to see if improvement in the testing occurs.

Vocational Aspects Based on the initial analysis of first year data the following hypotheses have been formulated for continued study during the next period:

1. **Vocational counseling and career guidance during pre-dialysis and early dialysis will increase vocational outcome.** The interview process revealed that only 3 clients out of 22 had knowledge

of available state vocational rehabilitation services. Many questions were also raised concerning kinds of jobs which might be suitable as well as obtainable in view of past experiences, training and work limitations resulting from ESRD. Early intervention may eliminate the development of financial dependency and enhance work motivation.

2. **Skilled ESRD clients are more likely to remain actively employed and/or find suitable employment than non-skilled clients.** An analysis of the working and non-working client populations indicates that the majority of those presently employed are working in positions which required prior vocational skill training while the majority not working are unskilled. Training programs in job areas suitable for an ESRD population will be developed and implemented in testing this hypothesis. hypothesis.
3. **A bio-engineering approach will increase the range and kind of jobs possible for ESRD clients by reducing physical exertion inherent in many job tasks.** Non-working clients with work experience prior to ESRD have reported that they are unable to return to former jobs due to inability to perform certain physically demanding job tasks. Low cost engineering technology will be applied in such cases to reduce or eliminate fatigue experienced in performing such tasks.
4. **Financial disadvantages create barriers to employment of the ESRD client.** Under present legislation, financial assistance is available to cover all dialysis related costs for individuals with extremely limited incomes. Individuals without prior insurance coverage, working full time, must bear the burden of 20% of the dialysis cost. A systematic study of the cost of ESRD health maintenance will be conducted and average costs tabulated. Recommendations for legislative change and/or alternative solutions will be investigated to alleviate this financial inhibition to return to or begin work.

Insight gained by project staff into problems faced by ESRD clients has resulted in the identification of needed research by other disciplines. Included are studies into the relationship of psychosocial variables as they relate to work motivation, work readiness and fatigue levels as well as medical investigations covering reduction of time loss due to secondary medical complications, and a method of determining work tolerance levels of ESRD clients as a guide to appropriate job development. Project staff have already notified appropriate personnel of RT-9, capable of conducting such studies, of the need for such research.

It is expected that further analysis of existing data and inclusion of more data obtained from staff involvement with a larger number of working-aged clients will result in identification and inclusion of additional hypotheses for subsequent testing.

APPLICABILITY: It is anticipated that the results of this project will impact the vocational rehabilitation counselors' management and, potentially, could suggest clinical management alternatives.

141 The Role of Family in Institutional Rehabilitation of Clients with Behavioral and Physical Disabilities

Principal Investigator:	**David Reiss, M.D.**	
Status:	**Continuing**	
Dates:	**July 1974-August 1979**	
Cost:	**Annual $91,370.79** **RT Annual $70,536.82**	**Projected Total $400,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#13, Page 68, R-45**	

OBJECTIVES: The **behavioral disability** phase seeks to predict rehabilitation outcome of patients with chronic behavioral disability based on characteristics of their families; the **physical disability** phase seeks to make similar predictions for patients with spinal cord injury and stroke.

METHODOLOGY:

1. The behavioral disability phase will use adolescent and young adults (A). The psychiatric patients who lived at home with both parents until hospitalization. All patients will have been admitted to an in-patient psychiatric service for the treatment and rehabilitation of alcohol, drug abuse and delinquency problems. Both parents will be included in the study. Some phases of the study require the professional staff and some administrators in the sponsoring institutions to serve as subjects. The

physical disability phase will use 10 spinal cord, 10 stroke patients, and 10 end stage renal disease patients. All 30 patients will have lived in intact families before being hospitalized. The spinal cord injured patients will be married males with at least one child over the age of 10; the stroke patients will be married males under 65, without significant cognitive impairment and have one unmarried child under the age of 30 living in the vicinity of the patient and available for testing.

2. Family, institutional and treatment processes, and outcome variables will be measured. Included in the variables will be the family's typical orientation to social problems and the particular Q-sort method. A standardized interview and questionnaire will measure structured and multiple family group including communication patterns, seating patterns, sociometric choices, and cohesiveness. Outcome variables will consist of estimates of the patient's overall improvement.

FINDINGS TO DATE:

1. In the behavioral disability phase, findings from 36 families show that laboratory assessment procedures permit families to be grouped into four categories based on the family's orientation towards novel and problematic social situations. This classification accurately predicts many aspects of the family's involvement in the treatment program; the degree to which the family is noticed by staff and other families, the extent to which the family can open itself to new advice and experience (rather than remain closed and self-protective) and the family's morale and sense of optimism about the treatment program.
2. The physical disability phase is just beginning and no data are available.

APPLICABILITY: Results of these studies should help rehabilitation staff to identify problem families within the first week or two of work with patients and their families. In particular, it should help to predict families who will undermine the treatment, simply fall from full attention or drop out of the program prematurely.

142 Post-Coronary Group/Exercise Therapy Study (Former Title: Rehabilitation of the Disabled Post-Myocardial Infarct Patient: Controlled Trial of Supervised Exercise vs. Group Counseling)

Principal Investigator:	**Patrick A. Gorman, M.D.**	
Status:	**New**	
Dates:	**May 1977-February 1981**	
Cost:	**Annual $84,962.68** **RT Annual $66,025.89**	**Projected Total $350,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#13, Page 86, R-48**	

OBJECTIVES: This project will compare the effectiveness of two separate treatment approaches, exercise therapy and group counseling, with each other and with a control group, in rehabilitating psychologically and/or physically disabled post myocardial infarction subjects. The object is to document changes in various vocational, psychological, physical, and social parameters following a twelve week intervention program and throughout a one year follow-up period.

The following outcome variables are examined in the three experimental groups to determine the rehabilitative effects:

1. **Vocational** - Return to gainful employment, number of hours employed, job related responsibility, income.
2. **Psychological** - Change in depression/anxiety scores; increase in 'positive' factors, i.e., 'carefree' on adjective check list.
3. **Physical** - Change in physical work capacity, heart rate and blood pressure responses and exercise induced arrhythmias and ST changes.
4. **Social** - Increased social, familial and recreational functioning: return to active sexual functioning.
5. **Morbidity** - Particularly, readmission to the hospital and/or occurrence of cardiovascular events.

6. **Mortality**

METHODOLOGY: One hundred and fifty patients will be admitted to the study over a 3 year period. The primary source of recruitment is The George Washington University Medical Center Coronary Care Unit. This is an eight bed unit which had 408 admissions in 1974, 474 in 1975 and 587 in 1976. The number of documented myocardial infarctions has been approximately one-third of all admissions (approximately 200 patients based on the 1976 census). We estimate that of this number, 20-25% (40-50 patients) will be eligible candidates for the study. We expect to access between 25-35 of these patients into the study each year. The remainder of the annual quota of 50 patients will be recruited outside the hospital through contact with internists and cardiologists who regularly refer patients to The George Washington University Medical Center Exercise Laboratory. Announcement of the program's existence will be sent to area medical societies and heart associations and to the community at large via public service announcements in newspapers, radio and television.

The primary steps will consist of:

1. Screening of hospital records.
2. Initial physical evaluation.
3. Psychological evaluation.
4. Randomization.
5. Rehabilitation programs;
    a. group counseling
    b. exercise training program
6. Follow-up evaluations.

FINDINGS TO DATE: Recruitment of participants for the project was started on 8/1/77. An outline of the Patient Flow Diagram (Appendix, Figure 1) and a request for patient referral was prepared and sent to attending physicians who regularly admit patients to The George Washington University Hospital and those who refer patients to the Exercise Laboratory. This outline was also sent to the local Medical Societies, Heart Associations and to the Heads of Cardiology in the area hospitals. With the collaboration of the Public Relations Department an advertising release was prepared for publication in local newspapers and for public service announcements on radio and T.V.

The staff of the Coronary Care Unit and Progressive Coronary Care Unit was given detailed orientation about the project in order to secure their cooperation in the recruitment process.

The project staff make regular chart rounds and identify those patients who fulfill the criteria for eligibility. When a patient appears to be eligible, the personal physician is contacted to secure approval for possible participation and the patient is briefly contacted and oriented, and requested to attend a screening session at least 6 weeks from the time of the acute myocardial infarction (Participant Flow Sheet, Appendix, Figure 2).

Eight patients have completed the screening execise test and depression/anxiety scales. All of these have also completed the first (comprehensive) evaluation: 17 have established their eligibility for participation, and one was found ineligible because of psychiatric disorders requiring treatment. The eligible patients include 16 males and one female. Eight are on vasodilators, three on antiarrhythmics, two on digitalis and two on diuretics. One has chronic atrial fibrillation. In the maximal exercise test performed at the first evaluation, the average exercise capacity was 5.95 METS with a range from 3.5-10 METS. Exercise was terminated because of reaching the maximal predicted heart rate in three, angina in four, other symptoms (dyspnea, fatigue, leg discomfort) in seven, marked ST segment depression in two and hypertension in one.

The first group of six was randomized to the group therapy program (see below). The second group of six was randomized to control. The third group of six should be complete and randomized in one week.

Observations On Initial Meetings Of Group Psychotherapy Subjects. The first cohort of six patients was randomized into the group therapy program. Each patient had previously completed the initial pre-group interview and was found eligible for study participation on physical and/or psychological grounds. Six hourly sessions have been conducted to date. Four members have attended 100% of the sessions; one has missed two sessions (due to a late start and a preplanned vacation) and another subject, a marginal participant, has thus far missed three sessions.

The patients, as a group, have been verbal and willing to share material concerning their infarctions and subsequent rehabilitation including medication usage, diet regimen, and physical activity. Half have also been open to explore personal feelings with regard to their marriages, sexual activity and pre-morbid behavioral attitudes. During the first session, subjects introduced themselves by describing their infarct history and subsequent rehabilitation experiences. This served as a basis for discussion during the following four sessions. Members discussed pre-morbid stresses leading to infarct onset including Type A personality characteristics which most felt they evinced; problems setting limits at work versus making decisions as to whether or not to return to work; communication difficulties with spouses, particularly situations where spouses allegedly used the post-MI situation to become more strident and overbearing; and sexual problems. Two handouts were given to all members in the third session which dealt with Type A behavior research and sexual aspects post myocardial infarction (topics which had generated the most discussion). During the fifth and sixth sessions, members spent a majority of time talking about physical symptomatology; the physiology of cardiovascular disease and the role of diet, exercise and medication in their own rehabilitation.

Throughout the first six sessions, the role of the leaders - a psychiatrist (or in his absence, a social worker) and a cardiac nurse - has been to act as catalysts promoting discussion on themes of concern to members and increasing cohesiveness by insuring that all members were involved. Attempts have been made to avoid a teacher-student model although at times, particularly in the discussion on physical symptoms and medications, this role had been adopted to some extent. During the next six sessions, attempts will be made to focus on individual problems described at the initial pre-group interview in order to help members achieve a more positive rehabilitation outcome.

APPLICABILITY: Too early in the study to determine applicability of results.

143 Identification of Communication Deficits in Patients with Right Cerebral Hemisphere Damage

Principal Investigator:	**Penelope S. Myers, M.A., C.C.C.**	
Status:	**New**	
Dates:	**May 1977-January 1981**	
Cost:	**Annual $26,200.62**	**Projected Total $125,000**
	RT Annual $20,293.17	**RT % of Annual Total 77%**
Annual Report Reference:	**#13, Page 108, R-49**	

OBJECTIVES:

1. Identify the specific communication deficits in patients with right cerebral hemisphere damage and develop a framework for the analysis of these deficits which will facilitate diagnosis and rehabilitation.
2. Develop a test protocol to assess the communicative deficits in patients with right cerebral hemisphere damage by: (1) examining the available standardized tests for specificity and sensitivity; and (2) developing tests for those areas where standardized tests fail to pinpoint deficits.
3. Develop guidelines to improve professional and family understanding of the communication deficits in patients with right hemisphere damage.
4. Hold training sessions with rehabilitation team members at GWU Medical Center as a means of improving their ability to communicate with right brain-damaged patients.
5. Counsel families of patients with right cerebral brain damage as a means of improving their ability to communicate with the patient.

METHODOLOGY:

A. Identification of target population and initial data collection
  1. Target population
    a. Sex: male and female; Age: 18-75 years
    b. Handedness: right
    c. Medical history: recent onset of right sided cortical lesion with no past history of neurological disease

2. Initial Data Collection
    a. Case History
    b. All the basic clinical variables for identification of site and size of lesion including all the clinical signs and symptoms reputed to have diagnostic significance.
    c. Results of routine tests using computerized axial tomography
    d. Interview with family and/or social worker
    e. Obtain results of standardized testing from speech, occupational and physical therapies

B. Identification of Communication Deficits

1. Interviews with: patient, family, rehabilitation team members
    a. Goal: to ascertain communication problems evident in social interaction and changes noted by family post onset
    b. Develop standard questionnaire to replace interview
2. Development of Test Battery
    a. Goal: development of a test battery sensitive to the specific disorders under investigation
    b. Rationale: Failure of standardized neuropsychological and language tests to identify communication disorders in the minor hemisphere
    c. Areas of test development
        (1) Cognitive: verbal and non-verbal
        (2) Affect (emotionally conveyed responses)
    d. Administration of tests to target population and age matched non-neurologically impaired controls
    e. Analysis of results and modifications of tests as needed

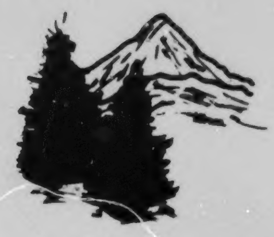
C. On the Basis of the Data Obtained

1. Develop a framework for analysis of right hemisphere communication deficits.
2. Develop printed guidelines to improve professional understanding of these deficits.
3. Lay the ground work for developing a standardized test battery

FINDINGS TO DATE:

1. Interviews: Results of interviews with patients, families, and rehabilitation team members have established the need for further investigation into right hemisphere communcation deficits. The major observation made in the five initial subjects was that while language function seemed unimpaired, communication was hampered in these patients.
2. Initial Questionnaire developed on the basis of the above unstructured interviews.
3. Standardized tests reviewed: selection of subtests from the Illinois Test of Psycholinguistic Abilities and the Hooper Visual Organization test.
4. Development of new tests in the areas of:
    (1) Mood recognition
    (2) Humor
    (3) Connotative language
    (4) Picture description and situation analysis

APPLICABILITY: The focus of this project is the identification of communication disorders involving: affect; visual imagery and internal image making; comprehension of connotative (versus denotative) language; shifts in cognitive style in which synthesis and integration of contextual cues has been sacrificed; increase in rigidity; and confabulation - none of which could be labeled aphasia and all of which impair communicative ability. The result of the study should expand the traditional diagnostic and rehabilitation services to include additional objectives for the remediation of the identified deficits. Family support programs would also be expanded to include counseling and strategies for dealing with the communicative disorders in right brain-damaged patients. With improved understanding of the nature of the communication problems in the right hemisphere patient, a more realistic vocational rehabilitation plan could be made.



University of Colorado (RT-10)
Medical Rehabilitation Research and Training Center

CORE AREA

Cardiopulmonary Rehabilitation

Research undertaken by the Center is practical, patient/client — oriented clinical research that is primarily derived from or utilized in the comprehensive patient care program for both in-patients and out-patients with coronary atherosclerotic heart disease. The coordinated research program dealing with major physiologic and psychologic problems in cardiopulmonary rehabilitation is designed to have a potentially direct impact on the primary or secondary prevention of disease or the prevention or modification of disability due to disease.

UNIVERSITY OF COLORADO

H. L. Brammell, M.D., Director
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Medical Rehabilitation Research and Training Center
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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

The Effect of Maximal Aerobic Exercise on Coagulation in Normals and Atherosclerotic Coronary Heart Disease Patients (H. L. Brammell, M.D.) 144

CONTINUING

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DISCONTINUED

Controlled Evaluation of a Comprehensive Rehabilitation Program Immediately Following Acute Coronary Events

Functional, Vocational and Psychosocial Evaluation of Post-Cardiac Arrest Patients

PROPOSED

The Effect of Propranol on the Conditioning Response in Normal Men

The Effect of Physical Training on Cardio-Respiratory Parameters Following Surgical Correction of Congenital Heart Disease

144 The Effect of Maximal Aerobic Exercise on Coagulation in Normals and Atherosclerotic Coronary Heart Disease Patients

Principal Investigator:	**H.L. Brammell, M.D.**	
Status:	**Completed (Pilot Study)**	
Dates:	**December 1977-December 1977**	
Cost:	**Annual $8,300** **RT Annual $6,700**	**Projected Total $8,300** **RT % of Annual Total 80%**
Annual Report Reference:	**#13, Page 15, R-14**	

OBJECTIVES: This pilot study was undertaken to evaluate the coagulation status of a small group of normals and patients with atherosclerotic coronary heart disease and to observe what changes, if any, result from maximal aerobic exercise.

METHODOLOGY: Ten normal subjects and ten post-myocardial infarction patients were evaluated before and after maximal treadmill exercise. The treadmill evaluation included a resting recumbent and standing 12-lead scalar electrocardiogram, continuous monitoring of the electrocardiogram throughout exercise and post exercise tracings immediately 1, 2, 5 and 8 minutes following exercise. Blood pressure was recorded at rest and each minute during exercise. Expired air was measured with the physiologic monitoring system (see R-9) and observations made of ventilation, oxygen consumptions, CO_2production, and respiratory quotient.

Blood was drawn without trauma (10 ml) before and immediately following maximal exercise. Coagulation factors evaluated included anti-thrombin III ReACT and ReACT plus 0.5 unit Heparin and Sonoclot, a measure of whole blood clotting. Sonoclot observations included time of onset, rate of clot formation, time to maximum clot formation, the ratio of rate of clot formation to time of onset and maximum height of Sonoclot trace.

FINDINGS TO DATE: The normal range of antithrombin III is 20 to 60 seconds. Normal values for the sonoclot determination on native whole blood are 2-4.5 minutes for onset, 4-8 units/min rate of clot formation with a normal ratio of rate to onset of 1-4. Normal value for ReACT is 140-190 seconds and the normal value for ReACT+0.5 units heparin is 265-420 seconds. When scanning the data, hypercoagulability is indicated by an anti-thrombin III time of less than 20 seconds with or without sonoclot onset less than 2 minutes, a rate of rise of the sonoclot of greater than 4 units per minute and sonoclot ratio of greater than 4. In addition, relative hypercoagulability is suggested by shorter ReACT times. Subjects JM and TB are hypercoagulable as indicated by the anti-thrombin III test. Subject JK is borderline in this regard. Following exercise JM and TB remained abnormal. JK remained borderline and AM became relatively more hypercoagulable. No normal subject was hypercoagulable although a trend toward hypercoagulability was noted following exercise. No such post exercise trend was apparent in the patients with atherosclerotic coronary heart disease.

COMMENT: It is known that exercise modifies laboratory measurements of coagulation in the direction of hypercoagulation. In patients with atherosclerotic coronary heart disease who are already predisposed toward an increased incidence of thrombotic episodes, exercise might exert an adverse influence. Although the coronary disease patients tended to be more hypercoagulable than the normal controls, exercise did not adversely affect their coagulation parameters. On the other hand, normal subjects tended to become relatively hypercoagulable as a result of exercise while remaining generally within normal limits. The level of physical conditioning was variable in the control subjects with coagulation values tending toward hypercoagulation in those who were least conditioned.

APPLICABILITY: Atherosclertoic coronary disease may be due to intravascular thrombosis (one of several theories of the etiology of atherosclerosis) and is certainly associated with an increased incidence of thromboembolic episodes. This pilot effort has shown that those with atherosclerosis tend to be hypercoagulable relative to normals and two of the ten patients with coronary disease were clearly abnormal as evidenced by their very short anti-thrombin III times. These data raise some important questions:

1. Does the coagulation status of individuals change prior to an acute clinical event, that is does the coagulation profile have predictive value?
2. Is it possible to select a high risk group by coagulation studies and by selection of a proper anti-clotting agent prevent clinical events and disability?

3. Is a person's coagulation status a risk factor for coronary disease?

Answers to these questions would have great impact in decreasing disability from coronary disease and maintaining clients at work.

145 Early Adjustment to Steady and Unsteady Exercise in Patients with Cardiopulmonary Disability

Principal Investigator:	**H.L. Brammell, M.D.**	
Status:	**Continuing**	
Dates:	**October 1975-May 1979**	
Cost:	**Annual $77,804** **RT Annual $77,804**	**Projected Total $250,000** **RT % of Annual Total 100%**
Annual Report Reference:	**# 13, Page 107, R-9**	

OBJECTIVES:

1. To evaluate the adjustments to steady and unsteady state exercise, particularly oxygen deficit, in patients with and without cardiopulmonary disorders.
2. To acquire a computer-based physiologic measurement system to monitor ventilation, oxygen consumption, and carbon dioxide production rapidly and on-line.

METHODOLOGY:

1. Construction of a physiologic monitoring system composed of a computerized data acquisition system and mass spectrometer (total gas and flow analysis instrument).
2. Utilizing the monitoring system to evaluate small groups of patients to:
    a. Establish normal oxygen deficit data in subjects without cardiopulmonary disease.
    b. Evaluate the hypothesis that oxygen deficit is greater in patients with functional impairment (New York Heart Association Class II or III) than in normals.
    c. Evaluate the oxygen deficit response in patients with angina pectoris.
    d. Evaluate the early adjustment to exercise in patients with varying degrees of obstructive lung disease.

Analysis of expired air during treadmill exercise, utilizing a bag collection system, carbon dioxide analyzer and fuel cell oxygen analyzer, was done on subjects. The following are some of the observations that were made or computed: minute ventilation, oxygen consumption, CO_2 production, respiratory exchange ratio, METS, anaerobic threshold, percent of maximum oxygen consumption at which anaerobic threshold occurs, heart rate, exercise electrocardiogram repolarization changes and abnormalities in heart rhythm, and blood pressure. Protocols were specific to the groups evaluated.

FINDINGS TO DATE:

a. The construction of a bag collection system for ventilation studies was completed.
b. Using the bag collection system, pre- and post-conditioning studies were done on a group of 15 elderly females between the ages of 63 and 81. Full physiological details are not yet completed, but clear evidence of a conditioning effect has been demonstrated.
c. An on-line computer-based model of the physiologic monitoring system was temporarily pieced together with borrowed items and used to evaluate the functional capacity of 15 professional football players. The data were not particularly surprising; however, the study gave us an opportunity to (1) evaluate a computer program for physiologic monitoring which will be incorporated in the final form system to be developed and (2) evaluate a group of individuals of high functional capacity which permitted vigorous testing of the entire system at high work loads.

Studies Performed During 1977:

Two major investigative activities utilizing the on-line physiologic measuring system were undertaken during 1977. Modification of the Anaerobic Threshold in Post Infarction Males utilized subjects with a relatively low functional capacity who had heart disease. The other, A Study of Older Marathoner Runners, involved subjects of very high functional capacity. These two activities provided us with experience with the equipment at both ends of the fitness spectrum.

It is apparent from these studies that the anaerobic threshold can be favorably modified in cardiac subjects. This improvement in the onset of anaerobic metabolic pathways is more marked for the percentage of maximum oxygen consumption than for the percent of maximum heart rate at which the anaerobic threshold appears. The significant improvement in the level of oxygen utilization and METS at the point of the anaerobic threshold indicates that with anaerobic training, the cardiac can perform work, recreational and conditioning activities of a considerably higher level without utilizing anaerobic metabolic pathways and increasing blood lactic acid concentrations. In addition, since work at a level which exceeds the anaerobic threshold is associated with muscle ache, muscle fatigue, hyperventilation and often nausea, the aerobically conditioned client should be able to work at a higher intensity and remain comfortable. An increase in productivity and decrease in rest requirements while at work should result although this is not proved.

The results of the scientific aspects of the latter study can be summarized.

1. Older marathon runners (non-world class) have a decrease of approximately 15 percent in oxygen utilization compared to early reports of younger marathoners. Previous studies by Costill have shown the average oxygen utilization to be 70 cc/kg/min whereas in this study of older runners the oxygen utilization was on an average 60 cc/kg/min.
2. The anaerobic threshold of marathon runners occurs at a high percent of maximum oxygen consumption capability and maximum heart rate. The respective values of 81.5 and 92 percent are considerably higher than those reported for unconditioned normal subjects.
3. Marathon runners compete at an average heart rate that is very close to the heart rate at which the anaerobic threshold occurs.
4. Arrhythmias are not uncommon during competition in marathon runners. Ventricular rhythms tend to occur early in the event (perhaps related to catecholamine release during initial portions of the race). Supraventricular rhythms tend to occur throughout the event.
5. Treadmill evaluation did not predict the occurrence of arrhythmias during competition with or without the added stimulus of high altitude.
6. With arrhythmias and repolarization changes occurring during competition it does not appear appropriate to ascribe them to inapparent asymptomatic heart disease.
7. The range of normal findings in a highly fit population may need to be broadened to include changes that traditionally have been considered abnormal.

APPLICABILITY: Methods which can detect physiologic changes that have the potential of early detection of deterioration, that suggest treatment modification and thereby maintain home, community, and vocational viability have great potential impact on the rehabilitative process. The long-range goal of this project when the monitoring system is completed is to record a series of important physiologic observations longitudinally on patients with cardiopulmonary disorders and to use these physiologic data as indicators of work modification and hopefully as predictors of rehabilitative success or failure.

146 Sequential Evaluation of Sensitivity and Predictive Accuracy of Treadmill Testing Following Myocardial Infarction

Principal Investigator:	**Paul Overlie, M.D.**	
Status:	**Continuing**	
Dates:	**May 1977-May 1979**	
Cost:	**Annual $30,249**	**Projected Total $70,000**
	RT Annual $30,249	**RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 77, R-11**	

OBJECTIVES: To test the following hypotheses:

1. That low sensitivity of the graded exercise test following myocardial damage is common.
2. That the low sensitivity following the acute myocardial infarction may explain the generally low sensitivity of treadmill tests in published series.
3. That a change from a normal to an abnormal repolarization response following myocardial infarction is predictive of new coronary events.

METHODOLOGY: All patients with a history of acute myocardial infarction who have had at least one graded exercise test in which the heart rate equalled or exceeded 85% of age-corrected maximum heart rate, or who reach a maximum tolerated level of exercise will be included. No patient taking a digitalis preparation, with electrocardiographic evidence of left ventricular hypertrophy, or non-specific repolarization changes at rest will be included in the study. Patients on propranolol will not be excluded on heart rate criteria. Since many patients have been followed for several years, all exercise tests performed on each patient will be evaluated. Each electrocardiogram and graded exercise test tracing will be read by two staff cardiologists without knowledge of the patient's name or subsequent history. A system for coding each patient visit to the exercise lab has been devised.

Patients enrolled in the cardiac rehabilitation program at the University of Colorado Medical Center have their first treadmill experience approximately 2 weeks after leaving the hospital. This is repeated at approximately 8 and 12 weeks following infarct, the latter time being the first maximum tolerated test. Exercise tests are then performed at 6 months following infarction and every 6 months thereafter. The data regarding sensitivity and predictive accuracy for true positives can therefore be calculated sequentially in this group of patients.

FINDINGS TO DATE: In early 1978 the computer to be used for storage of patient records was received. Upon receipt of the computer and reviewing the requirements of the project it became quite apparent that the simple coding system outlined last year for interpretation of the exercise electrocardiograms would be inadequate to answer all the questions raised in this proposal. Therefore, the initial task has been to create a more comprehensive patient data sheet for the exercise evaluations. This data sheet will be used to compile the data obtained by the Center over the past several years and in addition will be adopted for all prospective studies. We anticipate that certain changes will need to be made in the form as experience is gained with its use, however, in its current format it will permit us to complete this study within the next fiscal year.

APPLICABILITY: It is anticipated that if the population from which a patient submitted to a graded exercise evaluation is known, greater confidence/lack of confidence in the repolarization response can be applied to interpretation of the test. This, of course, does not mitigate against the great value of exercise stress testing in determining functional capacity and providing rational counseling for vocational, recreational, and reconditioning purposes.

147 The Effect of Low Level Aerobic Conditioning on Exercise Tolerance in Left Ventricular Dysfunction

Principal Investigator:	**H. L. Brammell, M.D.**	
Status:	**Continuing**	
Dates:	**June 1977-May 1979**	
Cost:	**Annual $11,240**	**Projected Total $16,000**
	RT Annual $9,478	**RT % of Annual Total 84%**
Annual Report Reference:	**#13, Page 95, R-12**	

OBJECTIVES:

a. Determine the safety of low-level supervised exercise in patients with left ventricular dysfunction.

b. Evaluate the efficacy of physical conditioning as regards:
   1. improved functioning capacity
   2. change in physiologic indicators of conditioning.

METHODOLOGY: Twelve male patients will be selected with LV dysfunction as a result of coronary artery disease and documented by cardiac catherization. Any other cause of pump failure will be excluded.

Each subject will act as his own control; the individual changes noted as a result of exercise will be monitored.

All patients will continue under the care of their own physician and will continue to follow his recommendations as to diet and medication. Approval of private physician for participation in study will be obtained. Data from study will be made available to attending physician.

Subjects will all agree to a fourteen week study and will sign appropriate consent forms. Each patient's chart will be reviewed and summarized.

On the basis of the subject's maximum tolerated heart rate (MHR) the training heart rate (THR) will be determined. Eighty-five percent of the patient's MHR will be the THR and should give a training effect. This will be the conditioning heart rate prescribed for each subject.

Training is probably best achieved when the subject reaches his THR and sustains it for 30 to 45 minutes at least 3 to 5 times weekly. Subjects participating in this study will be exercised in groups of six at their THR 3 times weekly for 34 minutes. All of the training exercises will be aerobic; anaerobic activities will be avoided.

During the training exercise sessions the following will be monitored:

a. Subjective status. Pre-exercise the subject will be asked how he feels and will not be exercised if there is any change in cardiac status, if he has contracted any cold, other infection or has other limiting changes in his health status.

b. Blood pressure will be taken before and immediately after the session.

c. Heart rate and rhythm will be monitored before, during each exercise and throughout the post exercise period with telemetry (Electrodyne).

c. Heart rate and rhythm will be monitored before, during each exercise and throughout the post exercise period with telemetry (Electrodyne).

d. All activities will be conducted in the Human Performance Laboratory, Webb-Waring Institute. All personnel involved in the study are certified by the American Heart Association in Basic Life Support. Equipment for cardiopulmonary resuscitation is maintained in the laboratory at all times.

Two baseline evaluations will be performed within a two week period. After three weeks of supervised exercise a complete evaluation as described earlier will be repeated. A new THR will be computed and an exercise prescription change made if necessary. Subjects will then continue the exercise program for three additional weeks. If no evidence of conditioning is seen, additional weeks of conditioning will follow. A total of 12 weeks may be required to determine if an optimal conditioning effect has occurred.

At the end of the training sessions a final evaluation will again be done. From these measurements any change in physiologic parameters will be noted. The subjects will be asked for a subjective physical status evaluation and for an estimate of work capacity for vocational and recreational activities.

FINDINGS TO DATE: No progress was made on this project during 1977. This project has been awarded a high level of priority for completion within the 1979 calendar year.

APPLICABILITY: If we can show that physical conditioning at appropriate levels is "good treatment" in patients with left ventricular dysfunction, then this information and the guidelines for its application should have broad utilization both in the management of patients in the rehabilitation program at the University of Colorado Medical Center as well as in other institutions and clinics throughout the country.

148 Echocardiographic Assessment of Ventricular Motion During Exercise

Principal Investigator:	**Donald Dick, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1976-October 1978**	
Cost:	**Annual $1,200** **RT Annual $1,200**	**Projected Total $1,200** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 46, R-162**	

OBJECTIVES: At the present time, echocardiography is helpful in the diagnosis of several types of cardiac disorders. In addition, this non-invasive tool has been used to evaluate certain aspects of left ventricular performance and has substantial value in this area. The use of ultrasound during exercise has not been systematically evaluated, either from an instrumentation or clinical point of view, and this is the principal objective of this project.

METHODOLOGY: Specific methodology for this project will include establishing limits for conventional ultrasound transducers, and the design, fabrication, and testing of new transducers with broader ultrasonic beam patterns. Testing and evaluation of the performance of these methods and systems during exercise with both normal and cardiac patients will be completed.

FINDINGS TO DATE: Most but not all of the project objectives have been achieved. Using conventional ultrasonic equipment the rotational limits of the transducer have been tested and with the subject in an upright position the transducer can be angled 15° in any direction and an interpretable echo through the left ventricular cavity obtained. Researchers designed, modified and tested a variety of transducers for use during exercise and obtained the best results with a 6 mm 2.25 MHz 1-3 cm short focus transducer. Five transducers were evaluated. While the 6 mm 2.25 MHz transducer gave the best results, this is not to say that it is the only unit which might function effectively. Other units included 13 mm 2.0 MHz standard unfocused transducer, a 13 mm 2.0 MHz defocused, 13 mm 2.0 MHz focused, and 6 mm 2.25 MHz 7.5 cm focused transducers. The transducer harness employed was simply a 4 x 4 x 1½ inch piece of stiff sponge through which a small hole was cut to accept the transducer. The sponge and transducer were then held in place on the subject's chest by an elastic bandage. This simple formulation provided adequate echocardiographic tracings at low work intensities on the treadmill.

Development of the microprocessor-based ultrasound system continues, a transmitter/receiver has been designed, constructed and is working. When completed the microprocessor-based ultrasound system will feature automatic adjustment of many previously manual settings, e.g. time gain compensation. In addition, there will be automatic quantitation of the echocardiographic signal amplitude. These features will simplify the obtaining of a suitable echocardiogram. Some preliminary studies have been done on normal subjects during low level treadmill exercise.

The fifth objective outlined in the initial proposal was to design and initiate a program to follow patients undergoing exercise as part of a cardiac rehabilitution program. This portion of the project has not been accomplished.

APPLICABILITY: In recent years the echocardiographic assessment of ventricular function has shown great promise and value, but it is expected that the value of this technique can be greatly enhanced by engineering applications to situations of cardiac stress, e.g., exercise.

149 Cardiopulmonary Adjustments to Exercise and Other Stresses

Principal Investigator:	**Giles F. Filley, M.D.**	
Status:	**New/Continuing**	
Dates:	**May 1977-May 1980**	
Cost:	**Annual $43,713** **RT Annual $43,713**	**Projected Total $120,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 56, R-163**	

OBJECTIVES:

a. To determine in normal subjects and patients with heart and lung disease the ventilatory drive precisely at the onset of exercise and as a function of the severity of steady state exercise.

b. To validate the fundamental disequilibrium chemistry believed to underlie the operation of the intrapulmonary reflex system which drives respiration. Methods of chemical validation will include study of disequilibria in shed blood in **in vitro** systems and in the deductions from the mathematical models so far developed to study blood gas disequilibria.

c. To measure carbonic anhydrase concentration and its activity in arterial plasma obtained from normal persons and from patients in clinical states associated with arterial hypoxemia.

METHODOLOGY: How respiration adjusts to sudden changes of exercise and is maintained in proportion to the severity of exercise so that arterial Po_2 stays constant is not understood even in normal subjects, let alone in those with heart and lung disease. Recently, however, we have obtained evidence that intrapulmonary chemoreception of respiratory gas disequilibria drives ventilation in normal subjects (R-161). Because the methods used to measure this drive are noninvasive, they can be used to test patients with heart and lung disease for their ability to adjust their breathing to the stress of exercise.

FINDINGS TO DATE: Progress toward all three objectives has been substantial.

a. The respiratory equipment needed to measure the human breath by breath response to CO_2 inhalation and its sudden removal has been improved upon so that now it is possible to deliver CO_2 during the first half or the second half of an inspiration. This was achieved by designing and building a 4-way valve activated by a vacuum line. This operates the valve so silently that the subject is not aware of its closing and opening, and rapid access to a new gas source can be achieved in less than a second.

b. Disequilibrium measurements. The acquisition of a rapidly responding miniature pH electrode and Brush recorder and the development of a system whereby a liquid phase (plasma or whole blood) in a thin film covered by a teflon membrane can be suddenly exposed to changed Pco_2 or Po_2 in a gas phase (system open to gas transfer, as in lungs), and then, a second or so later, placed in a closed system (such that CO_2 and O_2 cannot rapidly leave or enter the liquid phase, as in the systemic arteries), we have achieved the first of two physical models of pulmonary capillary blood gas exchange. (See Section C (i) for the second model.) Although still in its preliminary stages, the data we have obtained show the following:

c. (i) Carbonic anhydrase activity.

The second physical model of pulmonary gas exchange serves a triple purpose since it can also be used to quantitate the effect of carbonic anhydrase and indeed to assay for the activity of this enzyme in human specimens as small as 0.5 uliters. Briefly the pH stat (Radiometer) delivers 0.3 M HC1 from a 0.25 ml syringe to 2.5 ml of a buffered solution containing the substrate at the level in mixed venous blood ($NaHCO_3$ 0.027 M) as CO_2 is continually driven off in a stream of fine bubbles imitating the role of alveoli in removing CO_2. The rate of CO_2 removal (HCO_3—dehydration) is accurately followed by an exponential curve inscribed by a pen driven by a mechanism attached to the plunger of the 0.25 ml syringe and allows the determination of the kinetic dehydration constant k_{-1} at 38° in the pseudo first order reaction at constant H^+ concentration, (H^+),

$$d(HCO_3^-)/dt=K_{-1}(H^+)(HCO_3)/K^1$$

where K^1 is the ionization constant at the ionic strength of the solution (0.127). The value of k_{-1} has seldom been measured at 38° in an uncatalyzed medium resembling plasma and the values vary widely (between 32 and 89 sec^{-1}). Our method yields the very consistent value of 70 sec^{-1} at the two pH values so far used (7.40 and 7.54).

Adding human carbonic anhydrase (20 ul of a 10^{-5} M solution, final concentration 8×10^{-8}M) to the reaction mixture cuts the half time from ~60 sec to ~15 sec (i.e. increases $k_{observed}$ 4-fold). The kinetic parameters of the enzyme catalyzed reaction (K_m and k_{cat}, the turnover number) are being worked out.

Future addition of red cells to plasma in this system and determining the kinetics of blood gas exchange in a physiological in vitro system will complement the data of the first model.

(ii) Carbonic anhydrase detection by immunologic methods.

Antibody to human carbonic anhydrase C is produced in rabbits by initially administering bilateral subcutaneous injections of a water in oil emulsion containing the enzyme. Booster injections are given on the seventh day. On day 21, a serum sample from the animal is analyzed by double diffusion technique on an agarose plate against known concentrations of the antigen. The formation of a precipitate band between the antigen and antibody wells is indication of antibody-antigen complexes. Specificity of the complex for carbonic anhydrase is shown by incubating the plate in a cobalt sulfate-sodium bicarbonate solution and then developing in dilute ammonium sulfide. A black deposit of cobalt sulfide reveals carbonic anhydrase activity. If antibody titer is not sufficient, the animal is boosted a second time and its serum tested in 7 to 10 days. Once antibody titer is sufficient the animal is bled and the serum stored in small divided aliquots at −20°C.

Two milliliters of venous blood are obtained from normal volunteers and patients with respiratory disease. A double diffusion test on 1.2% agarose slide is run on each plasma sample. From this comparison a concentration is extrapolated for the plasma. The sensitivity of this test has been shown for concentrations of 10^{-7} mm.

APPLICABILITY: Planning of an exercise regimen for patients with cardiopulmonary disease requires knowledge of the special limitation to which these patients are subject. Thus their ability to deliver adequate 0_2 to their tissues following sudden exercise demands may be impaired, as recently shown by Auchincloss et al. (1976). The present investigation seems essential to the study of how such patients adjust to transient unsteady states of exercise and should help in planning rational and safe exercise programs for this type of treatment.

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University of Colorado

150 (Revised) Influence of Cardiovascular Function & Physiological Stress Loads on Psychological Efficiency. (Hypoxia & Cognitive Functions in Cardiovascular & Obstructive Pulmonary Disease Patients)

Principal Investigator:	**James W. McDaniel, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1976-September 1980**	
Cost:	**Annual $16,521** **RT Annual $16,521**	**Projected Total $75,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#13, Page 144, R-807**	

OBJECTIVES: To investigate the possible effects of cardiovascular disease upon selected aspects of behavior, and to determine the effects that exercise and physical conditioning may have upon cognitive and perceptual, and skilled motor performance in both healthy and coronary heart disease patients.

METHODOLOGY: The present project incorporates methods from R-807 and RP-3.

FINDINGS TO DATE: The methodology of this research has revealed significant, though not functionally severe, performance decrements due to coronary heart disease. These investigations and other needed instrumentation and procedures have not as yet progressed to the point that physiological explanations for those decrements can be identified. Present data do suggest some probable relationships between psychological capacities and cardiovascular-pulmonary functioning, which this project will pursue in conjunction with other ongoing research in our laboratories.

APPLICABILITY: Findings of this research are expected to illuminate the effects of coronary heart disease, but also to be of value to cardiac rehabilitation and reconditioning programs throughout the country. A significant outcome is also expected in terms of vocational adjustment of persons with coronary disease, since the research deals primarily with basic skills and performance necessary for occupational success, and the degree to which these skills are enhanced through rehabilitation programs.

University of Wisconsin-Madison (RT-11)
Waisman Center on Mental Retardation and Human Development

CORE AREAS

Rehabilitation of Families at Risk for Mental Retardation

Comprehensive family rehabilitation which has as its main objective the developmental aspects of retardation with the essential objective of normalizing family units in a variety of community settings that have been, to date, unapproachable utilizing traditional rehabilitation practices. This approach continues to attempt to demonstrate new rehabilitation techniques which will provide a systematic intervention point in ongoing community services delivery systems.

Rehabilitation of the Adolescent and Young Adult Retarded with Severe Behavior Deficits

The rehabilitation process of adolescent and young adult retarded and severely disabled persons with behavioral deficits which can serve as impediments to their effective vocational and/or social adjustment processes. This approach deals with the identification of and programming for severely disabled clients referred for evaluation purposes from active rehabilitation facilities programs.

Development of Community Alternatives for Severely Disabled Mentally Retarded Clients

The investigation of community alternatives with severely disabled retarded clients. In the absence of adequate community services for thousands of mentally retarded clients who have been relocated in a variety of community settings, these research techniques attempt to isolate the needs of these types of clients for habilitation and rehabilitation services. The rehabilitation program, with its current emphasis on the use of community resources in meeting the needs of each rehabilitation client, has the mandated responsibility of providing leadership in developing, implementing and integrating the diverse community services which are necessary to maximize the benefits of deinstitutionalization, both to the client and to society.

UNIVERSITY OF WISCONSIN

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED **ABSTRACT NO.**

Crisis Intervention Rehabilitation Applied Research Program for the Severely Developmentally Disabled (W. I. Gardner, Ph.D.) 151

CONTINUING

Establishment of the High-Risk Population Laboratory (R. F. Heber, Ph.D.) 152

A Longitudinal Study of the Social, Vocational, Legal and Family Status of Young Adult Mentally Retarded (R. F. Heber, Ph.D.) 153

Independence Training Program for Group Home Residents (P. J. Flanigan, Ph.D.) 154

NEW

Crisis Intervention Rehabilitation Applied Research Program for the Severely Developmentally Disabled: Development of an Extended Evaluation (W. I. Gardner, Ph.D.) 155

151 Crisis Intervention Rehabilitation Applied Research Program for the Severely Developmentally Disabled

Principal Investigator:	**W. I. Gardner, Ph.D.**	
Status:	**Completed**	
Dates:	**April 1975-March 1978**	
Cost:	**Annual $179,439** **RT Annual $113,337**	**Projected Total $381,143** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 23, R-40**	

OBJECTIVES: The major objectives of the applied programmatic research are: (1) to develop and evaluate rehabilitation procedures for use with the difficult developmentally disabled client, (2) to develop methods for the more efficient utilization of vocational rehabilitation personpower, (3) to develop methods for the more efficient utilization of vocational rehabilitation techniques to deinstitutionalize more of the developmentally disabled, and (4) to improve the quality of inter-agency linkages.

METHODOLOGY: Most of the research presently being conducted in this project is of an applied clinical nature. The main aim of this type of research is the assessment, treatment, and adjustment of the client for whom the research is done. This is different from other research which seeks information which does not benefit those persons who take part. This does not mean, however, that the applied clinical research conducted will not have implications beyond the client concerned. Each client served becomes the subject of an experiment where the sample size is one. Repetition of the procedures and results in other single-subject experiments help to confirm the generalizability of the findings and improve the overall external validity of the research.

In all cases, as clinical research studies within the project are planned, not only is a great deal of time focused on identifying the most appropriate designs for minimizing and controlling alternative rival hypotheses, but the procedures themselves are considered in terms of their practicality, feasibility, and utility within traditional rehabilitation centers and facilities. Further, measurement methods are selected which can be handled in typical applied, naturalistic settings. Thus, the research emphasis is on practical rather than statistical significance with a concurrent emphasis on vocational and social-personal behavior improvement.

The basic applied research strategy is one of designing highly individualized behavior change programs for each client based on his/her unique physical/psychological characteristics. The programs consist of a series of hypotheses about types of problems present, what they are relating to, and training program components which could best deal with the presenting problems. These hypotheses are stated in applied learning terms. A functional analysis of behavior approach is used to evaluate the adequacy of these hypotheses. Each client served produces considerable applied research information that has direct and immediate applicability to the types of problems presented by severely developmentally disabled persons.

FINDINGS TO DATE: On the basis of the work completed to date there have been many demonstrations that the principles and procedures of behavior management can be effective tools for improving functional vocational and social skills of the severely developmentally disabled. The tri-setting data-based developmental habilitation model of the Crisis Intervention Project appears to represent one example of the value of a coordinate and integrative network of habilitation transitional environments for maintaining and generalizing appropriate social/vocational client behaviors.

For those with the most severe disabilities, inter-agency planning and coordinated programming are absolutely essential. Systematic and consistent inter- and intra-programming efforts which complement and augment each other are critical factors in the deinstituionalization and habilitation of the severely developmentally disabled.

In spite of the new legislation with its emphasis on the more severely disabled, there seems to be a continuing trend among vocational rehabilitation agencies to unfairly discriminate in favor of clients who enter the vocational rehabilitation system with an adequate repertoire of prevocational and social-interpersonal skills. Those attempting to enter the system with substantial deficiencies in these areas are usually not given appropriate nor sufficient opportunities for demonstrating their capabilities. Specialized intervention programs, such as the Crisis Intervention Center, which utilize data-based behavioral procedures, may bring new meaning to the concept of extended evaluation and provide more vocational rehabilitation opportunities to the more severely developmentally disabled.

In summary, it appears as if there is sufficient knowledge and an appropriate habilitation technology for effectively serving developmentally disabled persons. However, in spite of this there is still a continuing tendency among vocational rehabilitation personnel to place the onus of responsibility for rehabilitation on the shoulders of the client. Although this model has provided impressive and cost effective data over the many productive years of vocational rehabilitation's existence, this model may not be appropriate for the more severely developmentally disabled. The rehabilitation counselor as a broker must be replaced by the rehabilitation counselor as a change agent. By the nature of this change, the training programs now being offered to rehabilitation counselors both those of an inservice and preservice nature, must be capable of providing the relevant skill training required for enabling them to take more impacting roles in serving developmentally disabled persons. The use of extended evaluation must be encouraged and its use must be predicated on more than simply the variable of time. Finally, the range and type of rehabilitation services must differ. At present, most communities consider themselves fortunate if they have one workshop and/or work activity center to serve all the clients. There is obviously a need for parallel program development so that different programs exist for those who are mildly and moderately handicapped and those who are severely and profoundly handicapped. Further, there should be developmental links between and among these programs so that all individuals have the opportunity for maximizing their competencies to the highest level in the least restrictive environmental setting which enables them to do this. It is believed that the Crisis Intervention Project offers such a model.

APPLICABILITY: The problems presented by the clients participating in this project are considered to be similar in nature to the problems presented by those developmentally disabled persons who vocational rehabilitation agencies usually consider to be hard-to-rehabilitate, and, in many cases, unfeasible for services. The applied nature of the research is designed to provide assistance not only to the clients that are presently participating in the project, but also to the counselors in the field who are presently faced with similar problems among their developmentally disabled clientele.

Since it may be expected that severely developmentally disabled clients will be coming to the attention of vocational rehabilitation agencies in greater numbers than they ever have before, it would appear that the time is right to reconsider some of the traditional evaluation and treatment procedures which have been used with more of the routine cases. The work within the Crisis Intervention project to date has continued to demonstrate that with appropriate evaluative and remediational strategies, it is possible to incorporate traditionally difficult clients into the rehabilitation system.

152 Establishment of the High-Risk Population Laboratory

Principal Investigator: **Rick F. Heber, Ph.D.**
Status: **Continuing**
Dates: **June 1966-June 1978**
Cost: **Annual $134,353** **Projected Total $2,110,601**
RT Annual $80,889 **RT % of Annual Total 60%**
Annual Report Reference: **#12, Page 4, R-1**

OBJECTIVES: Establishment of a High-Risk Population Category (Milwaukee Project) is a longitudinal study of the prevalence of mental retardation in a depressed urban area and the effects of a comprehensive rehabilitation program in preventing mental retardation.

METHODOLOGY:

1. The high-risk population laboratory was established with the aid of a door-to-door survey conducted in an area of metropolitan Milwaukee which had been previously identified as having an extremely high prevalence of retardation.
2. All members of the survey family, both children and adults, received an individual intellectual appraisal in addition to receiving several experimental learning and language tests. In addition, extensive data was obtained on family, social, education, and occupational history and status.
3. From this population pool samples are selected with the characteristics required by the individual studies being undertaken by the "high risk" population laboratory.
4. The population laboratory survey, over a period of a year, contacted all women residents in the area at the time of child birth. All family members were subsequently individually evaluated when

the mother was suspected of retardation on the basis of post delivery intellectual screening. This has made accessible a substantial number of mentally retarded young adults and their offspring.

FINDINGS TO DATE: The data derived from the project during the current grant period further extend previously reported data which indicated that the high prevalence of mental retardation found among disadvantaged population groups is accounted for, largely, by relatively small proportions of the population involved. (This research approach was initially established as a unique focus of the research program of the Center when little knowledge was available about the relationship of poverty to mental retardation.) Based upon this accumulated data, results show that the use of comprehensive rehabilitation of high risk families, families with a high prevalence of mental retardation, must be deemed a successful approach to the prevention of mental retardation.

The Center's second research category entitled "Learning Processes" consists of 16 language and learning activities which are conducted in conjunction with R-1 (Milwaukee Project) and which follows in the Directory. These research activities assess the development of children in a comprehensive family rehabilitation program and compares them to those who have not. In summary, the data continues to show more developmentally sophisticated patterns of responding on all measures of learning of the experimental group.

APPLICABILITY: Comprehensive family rehabilitation when used as an early intervention technique can effectively prevent mental retardation in high-risk children and can effect positive improvement in life skills of other members of the family.

In addition the results of this study seriously question present policy with respect to the allocation of social services to population groups. Where epidemiological and process variables are ignored and only demographic variation between groups is the basis for determining resource allocation the delivery of health and social services are doomed to be ineffective and inefficient.

153 A Longitudinal Study of the Social, Vocational, Legal and Family Status of Young Adult Mentally Retarded

Principal Investigator:	**Rick Heber, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1975-March 1981**	
Cost:	**Annual $74,340**	**Projected Total $490,000**
	RT Annual $37,725	**RT % of Annual Total 51%**
Annual Report Reference:	**#12, Page 49, R-41**	

OBJECTIVES: The question remains as to what can be done to reduce this problem. It would first be necessary to develop detailed information about this population of retarded adolescents and young adults. We need to know who they are, the nature of their social and educational development, the characteristics of their family etc., and most importantly the factors which lead to social and legal difficulties and vocational inadequacy. Subsequently, a program of ameliorative action would be implemented and tested. The program would attempt to intervene in these individuals' lives in order to effectively minimize or prevent the development and manifestation of serious problems of adjustment.

METHODOLOGY: The implementation of this study first requires the identification of such individuals. Cooperation of the public school and local social agencies will be enlisted. A group of adolescents will be identified and closely studied. We will attempt to follow them upon termination of schooling for at least two years to determine the factors influencing social, vocational, emotional, legal and family problems.

Subsequently (i.e. subsequent to identification but prior to the two year study) we will divide the group into two comparable groups in order to test the effectiveness of our intervention program. One group will remain untreated and only observed for comparison purposes to our treated group. The program of intervention for the treated group will test a variety of approaches to prevent the occurrence of these difficulties, such as through (1) crisis intervention, (2) continuing supportive guidance, (3) environment manipulation, and (4) adult education.

FINDINGS TO DATE: During the past year we continued to work at three levels: (1) continuing our epidemiological survey of the adolescent retarded; (2) developing assessment instrumentation for determining client status; and (3) an assessment of attitude and awareness of the retarded in the community.

APPLICABILITY: The result of this research will provide an understanding of the life process of the high-risk adolescent and young adult retarded. By understanding the characteristics of these individuals it should be possible to selectively identify those in need, the nature of their need and the kind of rehabilitation therapy with which to intervene. Ultimately this work will lead to the prevention of adjustment problems facilitating job placement and to developing social and recreational skills. In addition, this research represents a downward extension of our concern for the family at risk. It is presumed that the target population of this stu[illegible]tain a large number of individuals who will become parents at risk. This procedure ther[illegible]uld increase the effectiveness and efficiency of preventive rehabilitation programming.

154 Independence Training Program for Group Home Residents

Principal Investigator:	**P. J. Flanigan, Ph.D.**	
Status:	**Continuing**	
Dates:	**October 1977-September 1978**	
Cost:	**Annual $58,585**	**Projected Total $50,000**
	RT Annual $45,208	**RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 68, R-43**	

OBJECTIVES:

1. To develop a hierarchy of self help, domestic and community-living skills required to maximize independent functioning of mentally retarded persons living within the community.
2. Preparation and evaluation of an administration manual detailing an instructional program based on sequential training techniques to be used by Daily Living Coordinators working in group homes with mentally retarded persons.

METHODOLOGY:

1. Development of a skill hierarchy through interviews and information collected from standardized adaptive behavior measures completed by 150 group home Daily Living Coordinators.
2. Presentation of an individualized skill hierarchy assessment technology and instructional program methodology to DLCs for evaluation.
3. Revision of the program followed by assessment of the revised product's validity to be established through in-home training and follow-up.

FINDINGS TO DATE:

1. The skill hierarchy and instructional program have been completed following group inservice training.
2. Validation of the revised program is being conducted.

APPLICABILITY: Community adjustment of mentally retarded persons requires strong community living skills training. This program will allow the Daily Living Coordinator to use evaluative information to assess skill deficits and implement a training methodology to raise these skills to acceptable levels.

155 Crisis Intervention Rehabilitation Applied Research Program for the Severely Developmentally Disabled: Development of an Extended Evaluation

Principal Investigator:	**W. I. Gardner, Ph.D.**
Status:	**New**

University of Wisconsin

Dates:	**April 1978–March 1981**	
Cost:	**Annual $205,062** **RT Annual $123,929**	**Projected Total $615,186** **RT % of Annual Total 60%**
Annual Report Reference:	**#12, Page 78, R-45**	

OBJECTIVES: The major objectives of the project are: (1) the development of an extended evaluation system for assessment and training of the severely developmentally disabled, (2) to develop, through an extended evaluation method for the more efficient utilization of vocational rehabilitation person power, (3) to develop, through an extended evaluation system, methods for the more efficient utilization of vocational rehabilitation techniques to deinstitutionalize more of the developmentally disabled, (4) to improve the quality of inter-agency linkages.

METHODOLOGY: The methodology utilized in the initial three years of the Crisis Intervention Project will continue to be used in this project period. The basic applied research strategy is one of designing highly individualized behavior change programs for each client based on his or her unique physical/psychological characteristics so as to provide information relevant to one of the research core areas of the project. The programs consist of a series of hypotheses about the types of problems present, what they are related to, and the training program components which could best deal with these problems. These hypotheses are stated in applied learning terms, and a functional analysis of behavior approach is used to evaluate the adequacy of these hypotheses. Finally, each client served produces considerable applied research information that has direct and immediate applicability to the types of problems presented by severely developmentally disabled individuals.

To date a considerable amount of knowledge has already been accumulated and disseminated. In the course of the project a series of intervention strategies have been identified for dealing with a sizeable number of personal-social-vocational deficits related to behavior/learning problems. By using our hypotheses generating system and then selecting treatment strategies based upon an individualized assessment, a close and interactive conceptual link between evaluation and treatment processes has been assured.

As stated, the purpose of the present phase of the project will be to obtain more of an empirical base for our evaluation-treatment system as a critical first step toward matching various client-setting characteristics with specific treatment strategies. As noted, the same basic methodology described above as used in the initial three-year phase will continue to be used in developing this empirical base. To illustrate, if a client's presenting problems are considered to be related to his/her difficulty at identifying relevant cues for guiding his/her behavior, our present knowledge base suggests that there are at least seven different treatment strategies we believe could be used to remediate problems related to this difficulty. Although it is our contention that this represents a significant step forward in closing the gap between evaluation and treatment, further data are obviously required to help determine, based on a particular client's specific entry characteristics, learning history, environmental demands, and so forth, which of these strategies has the greatest probability of success particularly for him/her. As this data base develops, further testing will be used to assess the validity and practicality of using these strategies for selected sets of commonly observed client deficit and excessive characteristics.

FINDINGS TO DATE: During the three years of its existence, the Crisis Intervention Project, in response to the mandates for serving the more severely disabled imposed by the Vocational Rehabilitation Act of 1973, has developed and continues to refine a vocational habilitation/rehabilitation applied research, professional training, and service delivery model specifically for the severely developmentally disabled. The key features of this model are: (1) the technology used is based upon a broadly-defined learning theories approach with an applied behavior analysis emphasis, (2) there are separate but inter-related developmental stages of client programming, (3) a variety of agencies and service providers are all active participants in client programming, and (4) all client participants are considered either unrehabilitatable or hard-to-rehabilitate by vocational rehabilitation personnel.

APPLICABILITY: It appears as if there is sufficient knowledge and an appropriate habilitation technology for effectively serving developmentally disabled persons. However, in spite of this there is still a continuing tendency among vocational rehabilitation personnel to place the locus of responsibility for rehabilitation on the shoulders of the client. Although this model has provided impressive and cost effective data over the many productive years of vocational rehabilitation's existence, this model may not be appropriate for the more severely developmentally disabled. The rehabilitation counselor as a broker must be replaced by the rehabilitation counselor as a change agent.

By the nature of this change, the training programs now being offered to rehabilitation counselors both those of an inservice and preservice nature, must be capable of providing the relevant skill training required for enabling them to take more impacting roles in serving developmentally disabled persons. The use of extended evaluation must be encouraged and its use must be predicated on more than simply the variable of time. Finally, the range and type of rehabilitation services must differ. At present, most communities consider themselves fortunate if they have one workshop and/or work activity center to serve all the clients. There is obviously a need for parallel program development so that different programs exist for those who are mildly and moderately handicapped and those who are severely and profoundly handicapped. Further, there should be developmental links between and among these programs so that all individuals have the opportunity for maximizing their competencies to the highest level in the least restrictive environmental setting which enables them to do this.

University of Arkansas (RT-13)
Vocational Rehabilitation Research and Training Center

CORE AREAS

Rehabilitation Counseling

The discovery and development of knowledge and skills resulting in greater effectiveness of rehabilitation counselors as helpers with clients demonstrating psychological and vocational difficulties.

Psychosocial Treatment Strategies

The discovery and development of psychosocial treatment programs specifically for use by rehabilitation practitioners with clients and modified existing treatment programs for the special needs of rehabilitation settings or specific rehabilitation populations.

Program Evaluation

The discovery and development of procedures and techniques for systematically evaluating the effects of rehabilitation services on client adjustment

UNIVERSITY OF ARKANSAS

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

	ABSTRACT NO.
Dimensions of Rehabilitation Outcome: A Factor Analytic Study of Several Measures of Client Change (B. Bolton, Ph.D.)	156
The Use of Self-Instructional Training Materials with Rehabilitation Personnel (An Evaluation of Vocational Rehabilitation Counselor Functions: A Self-Instructional Training Package) (R. C. Farley, M.S.)	157
A Comprehensive Evaluation of the Relationship Between Disability and Personality Functioning: Implications for Rehabilitation Counseling (B. Bolton, Ph.D.)	158
Application of Personal Achievement Skills to Personal Adjustment Training for the Blind (R. Roessler, Ph.D.)	159

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SUBSUMED

The Development of an Improved System for Measuring Client Outcome

Evaluation of the RIDAC (Rehabilitation Initial Diagnosis and Assessment for Clients) Project for the Arkansas Rehabilitation Service

Developing a Model for the Analysis of Case Movement in a Vocational Rehabilitation System

Development and Evaluation of a Set of Systematic Training Units to Increase or Decrease Selected Client Behaviors

156 Dimensions of Rehabilitation Outcome: A Factor Analytic Study of Several Measures of Client Change

Principal Investigator:	**Brian Bolton, Ph.D.**	
Status:	**Completed**	
Dates:	**January 1975–August 1977**	
Cost:	**Annual $4,535** **RT Annual $2,841**	**Projected Total $10,000** **RT % of Annual Total 63%**
Annual Report Reference:	**# 13, Page 219, R-121**	

OBJECTIVES: In determining the major dimensions underlying client change and outcome as a result of the provision of rehabilitation services, the project attempts to:

a. delineate the major dimensions of client outcome;
b. operationally define these dimensions using currently available measuring instruments, and;
c. provide program evaluators with a handbook for addressing the criterion problems.

METHODOLOGY:

1. The sample consisted of 120 general caseload clients of the Arkansas Rehabilitation Service.
2. The following data were collected at acceptance for service and closures: ARS Client Outcome Measure and ARS R-300 Client data.
3. At acceptance and closure clients in the sample completed the Mini-Mult and the Human Service Scale.
4. Factor analysis of various sets of variables and change scores was the primary statistical technique.

FINDINGS TO DATE: Results of this project will be published as articles in the **Rehabilitation Counseling Bulletin**:

"Rehabilitation Client Needs and Psychopathology"

The central focus of this investigation was the construct validity of the Human Service Scale (HSS), an instrument that purports to measure 7 dimensions of clients' needs that parallel Maslow's need categories. The HSS & the Mini-Mult were completed by 117 clients at the time of acceptance for rehab services. Statistical analyses of the intercorrelations among the subscales of the two instruments supported two conclusions: (1) The Physiological and Emotional Security subscales of the HSS are highly saturated with psychopathological symptomatology, and (2) The remaining five HSS subscales measure dimensions of clients' psycho-social and vocational adjustment that are relatively independent of psychopathology.

"Client and Counselor Perspectives in the Assessment of Client Adjustment"

This investigation was designed to address the issue of client and counselor perspectives in client assessment. 103 clients completed the HSS and were evaluated by their counselors using the Client Outcome Measure at the time of acceptance for rehab services. Statistical analyses of the interrelationships between the two independent assessments led to three conclusions: (1) Client and counselor perspectives tend to converge at the theoretical level, (2) The modest magnitude of the correlations indicates that clients and counselors are seldom in close agreement in their judgments, and (3) Discrepancies between clients' and counselors' responses on relatively objective items suggest a ceiling on the degree of convergence that may be obtained. Implications of these results for rehabilitation counseling are discussed.

"Dimensions of Client Outcome: A Replication"

Thirty-one clients completed the HSS and were evaluated by their counselors using the Client Outcome Measure at the time of acceptance for rehab services and again at closure. Statistical analysis of the residual change scores suggested two conclusions: (1) Economic-vocational measures of client change during the rehabilitation process are relatively independent of personal-social-family indices of adjustment, and (2) Economic-vocational improvement may be facilitated in self-perceived emotional security. Despite several limitations, the results were generally consistent with those of the previous investigation.

APPLICABILITY: The isolation and operational definition of the major dimensions of client outcome will enable program evaluators to place their accountability analyses on a solid scientific foundation.

157 The Use of Self-Instructional Training Materials with Rehabilitation Personnel (An Evaluation of Vocational Rehabilitation Counselor Functions: A Self-Instructional Training Package)

Principal Investigator: **Roy C. Farley, M.S.**
Status: **Completed**
Dates: **January 1975–July 1977**
Cost: **Annual $5,027** **Projected Total $25,000**
RT Annual $3,145 **RT % of Annual Total 63%**
Annual Report Reference: **# 13, Page 40, R-131**

OBJECTIVES:

1. To assess the value of **Vocational Rehabilitation Counselor Functions: A Self-Instructional Training Package.**
2. To measure the effectiveness of the package in teaching the intended principles and concepts.
3. To evaluate users' attitudes toward the package.

METHODOLOGY:

1. Two random sample groups were selected from a population of rehabilitation counselors and rehabilitation counselor students.
2. A series of tests, based upon counselor functions presented in the training package, were given to all participants to determine present level of knowledge of the principles and concepts.
3. Participants were asked to work through each self-instructional manual.
4. The tests were readministered to determine the extent to which concepts and principles were learned.
5. Participants were asked to complete an attitudinal evaluation test designed to rate the package on a 5 point scale, ranging from poor to excellent, with mid-point being the minimally acceptable level.

FINDINGS TO DATE: Topics covered by the self-instructional manuals are:

1. Rehabilitation Counselor Code of Ethics
2. Developing Referral Sources: Effective Casefinding
3. Structuring the Counselor/Client Interaction
4. Basic Principles for Determining Client Eligibility
   a. General Provisions
   b. Evaluation of Rehabilitation Potential
   c. Extended Evaluation for Determining Rehabilitation Potential
   d. SSDI and SSI Cases
5. Case Recording
6. Managing the Flow of Cases
7. Confidentiality of Information

   Major findings of the study are:

   a. Self-instructional training material is an effective approach to teaching rehabilitation students and counselors basic principles and concepts related to the job functions of a rehabilitation counselor.
   b. Rehabilitation students and counselors were able to increase their knowledge of the subject matter contained in the Vocational Rehabilitation Counselor Functions training package to a point better than ninety percent mastery.
   c. Rehabilitation students and counselors reacted favorably to the material.
   d. A majority of rehabilitation students and counselors completing the training material think the package is appropriate for training rehabilitation counselors and is effective in preparing them to perform day-to-day activities of the job.

APPLICABILITY: With an increasing demand on the rehabilitation counselor's time, the need is apparent for training materials which require little time and are both effective and inexpensive. This package was developed in response to that need.

158 A Comprehensive Evaluation of the Relationship Between Disability and Personality Functioning: Implications for Rehabilitation Counseling

Principal Investigator: **Brian Bolton, Ph.D.**
Status: **Completed**
Dates: **September 1975-September 1977**
Cost: **Annual $7,038** **Projected Total $28,000**
RT Annual $4,403 **RT % of Annual Total 63%**
Annual Report Reference: **# 13, Page 133, R-139**

OBJECTIVES:

1. To assess the extent of relationship between disability type and patterns of personality functioning for eleven groups of rehabilitation clients.
2. To review and summarize relevant literature in a series of tabular presentations.
3. To draw implications for rehabilitation counselors of any obtained differences in terms of hypothesized behavioral functioning of rehabilitation clients.
4. To conduct item factor analysis of two of the instruments for purpose of assessing their construct validity with rehabilitation clients.

METHODOLOGY:

1. Sample will consist of approximately 300 rehabilitation clients who participated in a nationwide study of the rehabilitation counseling process.
2. Four instruments were administered to the clients at the time of acceptance for rehabilitation services. The instruments are classified into three areas of personality functioning:
   a. psychopathology,
   b. self-concept, and
   c. normal personality.
3. The major statistical analyses will include:
   a. Comparisons of the eleven disability groups on the subscales of the various instruments. Analyses of variance will be followed by Duncan's Multiple Range Test.
   b. Principle components analyses and Varimax rotations will be used to isolate homogeneous clusters of items which reflect client response patterns on the Tennessee Self-Concept Scale and the 16 PF (Form E). Recent research (Howarth and Browne, 1971) and reviews (Bentler, 1972) have questioned the dimensionality, and thus the validity of the scoring systems, of the 16 PF and the TSC respectively.

FINDINGS TO DATE:

I. 1. Disability and Self-Concept: A Comparative Investigation.

A nationwide sample of 326 rehabilitation clients representing twelve disability groups completed the Tennessee Self Concept Scale (TSCS) at the time of acceptance for services. Statistical comparisons were made among the twelve groups on 14 selected TSCS scales.

Conclusions:

a. Disablement has a significant negative impact on self-concept.
b. Individual response to disablement is extremely variable.
c. Some disabilities have a more severe impact on self-esteem than others.
d. The analyses results suggested that many physically disabled clients who report favorable self-concepts may be protecting themselves against an underlying tendency toward serious emotional disturbance.

2. Factorial Validity of the Tennessee Self-Concept Scale.

This investigation was designed to compare the factorial structure of examinees' responses to the

Tennessee Self Concept Scale to the rationally derived subscale structure of the instrument. Oblique rotations of four variable sets which represent successive condensations of the TSCS item sample were carried out.

Conclusions:

a. The presence of three positive and three negative items within each of the 15 combinations of content (three perspectives and five selves) does not effectively control for acquiescence responding.

b. The three design facets of the FSCS (direction, perspectives, and selves) clearly interact in defining the dimensions of examinee response to the 90 items.

c. The factorial structure of the examinees' responses to the 90 TSCS items is generally not consistent with the rational design of the instrument.

II. 1. Disability and Psychopathology: A Multitrait-Multimethod Investigation.

This investigation was designed to address three major research questions concerning the relationship between disability and psychopathology.

a. To assess the relative degree of emotional disturbance among 12 disability groups on the standard psychopathology scales of the Mini-Mult and the PSS (an evaluation of the dimensional hypothesis).

Conclusion:

The dimensional hypothesis was supported by the Mini-Mult and PSS comparisons.

b. To assess the relationship between nature of disabling condition and psychopathological classification using statistically generated Mini-Mult profile groups (an evaluation of the typological hypothesis).

Conclusion:

The cross-tabulations of disabling condition by two independently derived Mini-Mult profile cluster schemes did not support the typological hypothesis in the domain of self-reported psychopathological symptomatology.

c. To assess the relationship between clients' views of their psychological adjustment (measured by the Mini-Mult) and the agency's view of the extent of the clients' psychopathology (measured by the PSS) (an evaluation of the perspectives hypothesis).

Conclusion:

The substantial correlations between the Mini-Mult and PSS provided overwhelming support for the perspectives hypothesis in the realm of psychopathological assessment.

2. Psychologist vs. Client Perspectives in the Assessment of Psychopathology.

The Minnesota Multiphasic Personality Inventory (MMPI) and the Psychiatric Status Schedule (PSS) were administered to two samples of clients. The MMPI summarized the clients' subjective views of their emotional status while the PSS provided an "objective" assessment from the psychologists' perspectives. Statistical analyses of the resulting multivariable-multimethod matrix revealed a substantial convergence of client and psychologist perspectives; however, the implication of these findings for clinical and counseling practice is that the MMPI (or any of its short forms) should not be used alone in diagnosing the nature and extent of emotional disturbance; some form of structured interview should be employed to provide an additional perspective on the client's self-perceived distress, as well as ascertaining unique information regarding the degree of impairment in other areas of functioning.

III. 1. "The Factorial Validity of 16PF-E with Rehabilitation Clients"

A comprehensive review of the published factorial studies of the 16PF suggests that the evidence is divided regarding the validity of the 16 primary factors. The 16PF-E, which was designed for use with persons of limited educational and cultural background, was administered to a heterogeneous sample of 449 rehabilitation clients. Factor analyses of 128 items, 32 parcels, 16 scales and 16 change scores were conducted. Conclusions:

a. The second-order personality structure of the 16PF received strong support in this investigation. While Factor IV (Independence) did not assume its previously verified pattern in any of the analyses, this could be due to idiosyncracies of Form E or the very heterogeneous subject sample.

b. The consistent replication of the secondaries implies that the structural relationships among the primaries are replicable; however an independent analysis of the 128 items provided direct evidence for the 16 primary factors.

c. Form E of the 16PF, which is the newest and least well refined of the five forms of the popular questionnaire, appears to be measuring the dimensions of Cattell's normal personality

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sphere as well as the more established forms.

   d. While the available evidence for the factorial validity of the 16PF is far from unanimous, it certainly does not justify the negative conclusions reached by some psychologists. When evaluated by reasonable standards the 16PF compares favorably with any other inventory that purports to measure variations in normal personality functioning.

2. "Disability and the Normal Personality Sphere: A Comparative Investigation"

   A comprehensive literature review examined two dozen studies of disabled persons using the 16PF Questionnaire.

   Conclusions:

   a. A synthesis of the results of 19 investigations suggested that the following personality manifestations may be associated with disablement: tendency toward introversion, increased anxiety, inclination to pathemia, decreased evidence of independence, and lowered superego strength.

   b. The synthesis only partially confirmed "Cattell's hypothesis" concerning a generalized effect of physical disablement. Specifically, Cattell argued that the typical disability-related personality profile was different from neurosis; however, the current evidence is entirely consistent with the 16PF secondary anxiety factor.

   The 16PF-Form E was completed by 326 rehabilitation clients representing 12 disability groups.

   c. In comparison to the 16PF-E norm groups, which consist of rehabilitation clients and other disabled persons, the research sample was more intelligent, liberal, confident, and relaxed.

   d. When the 12 disability groups were compared on each of the 16PF primary source traits, eight factors were statistically significant. It was concluded that the dimensional hypothesis regarding disability and the normal personality sphere was partially supported.

   e. A hierarchical cluster analysis of 262 client profiles generated three levels of highly discriminable personality clusters. There was a statistically significant relationship between broad disability type and profile group membership. It was concluded that the typological hypothesis received slight support in this investigation.

APPLICABILITY: The importance of psychological variables in the rehabilitation process has been documented in research as well as the experience of practitioners. This investigation was premised on the assumption that improved understanding of client psychological variables will result in more appropriate and efficient rehabilitation services.

159 Application of Personal Achievement Skills to Personal Adjustment Training for the Blind

Principal Investigator:	**Richard Roessler, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1975-February 1977**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $8,000** **RT % of Annual Total (not specified)**
Annual Report Reference:	**# 13, Page 141, R-144**	

OBJECTIVES:

1. To provide Personal Achievement Skills (PAS) training to adjustment personnel working with blind clients.
2. To adapt PAS training materials to blind clients.
3. To conduct an applied field study of PAS in two rehabilitation facilities for the blind — Arkansas Enterprises for the Blind (AEB) and Criss Cole Rehabilitation Center for the Blind (CCRCB).

METHODOLOGY:

Phase I—Training of Trainers

Training in the PAS program was conducted by RT-13 personnel for participating counselors in both facilities.

Phase II—Development of Materials

PAS materials were converted into a PAS package appropriate for use with blind clients.

Phase III—Completion of a Field Study.

Consenting clients from the regular rehabilitation program of Arkansas Enterprises for the Blind were randomly assigned to experimental (receiving PAS training) and control (not receiving PAS training) groups. Program outcome data were collected from client, facility and agency perspectives. Pre and post measures on both client groups were obtained and compared—i.e., profiles in skill development at the beginning and end of the program, regular rehabilitation outcome data, and R-300 data were compared.

FINDINGS TO DATE: Original project plans included field testing at two facilities for the blind. Due to a change in clientele toward the multiply handicapped (deaf-blind individual) Criss Cole Center was not able to participate in the research phase of the study. Research efforts were completed at Arkansas Enterprises for the Blind (AEB).

The study involved 34 clients enrolled in the 12 week personal adjustment program at AEB. Of those students qualifying for the research (IQ 70 or above, braille skills, and projected 12 week enrollment in the adjustment program), 16 were in the experimental group and 18 in the control group. Since subjects were assigned to the experimental and control groups on a random basis, no differences were found between the two groups on most demographic variables; however, the control group was somewhat older (average age of 32) than the experimental group (average age of 26).

Promising results from the use of Personal Achievement Skills (PAS) with the visually handicapped were found. Although the control group was also involved in group counseling, the experimental PAS clients reported greater gains in self-esteem and trends toward higher self-report gains in goal attainment from pre to posttesting.

The unique contributions of PAS to personal adjustment training for the visually handicapped seem to fall into two categories; e.g., it teaches specific skills of behavioral self-control and enables individuals to develop through the accomplishment of a personally meaningful goal. The way in which PAS accomplishes these objectives is operationalized in the exercises and activities presented in the PAS Leader's Manual for the visually handicapped (Roessler and Means, 1977).

APPLICABILITY: It is anticipated that PAS will provide workers for the blind with an additional tool for involving blind clients in the development of their own rehabilitation program.

160 Research on the Psychosocial and Vocational Adjustment of Spinal Cord Injured Clients

Principal Investigator: **Daniel Cook, Ph.D.**

[illegible] **Continuing**

[illegible] **March 1974-June 1978**

Cost: **Annual $22,317** **Projected Total $82,000**

RT Annual $13,961 **RT % of Annual Total 63%**

Annual Report Reference: **# 13, Page 81, R-125**

OBJECTIVES:

1. To design a comprehensive research and evaluati[illegible]ategy to assess the effectiveness of a model Regional System of Spinal Injury Rehabilitati[illegible]
2. To implement Personal Achievement Skills Training with a group of SCI at the Hot Springs Rehabilitation Center.
3. To complete a comprehensive review of the research literature dealing with psychosocial and vocational attributes of the SCI.
4. To implement a comprehensive research and evaluation strategy assessing the effectiveness of a Model Regional System of Spinal Cord Injury Rehabilitation.
5. To describe the sample of SCI persons making use of project services.
6. To assess the extent to which SCI clients' personal, social, and vocational needs are met by the rehabilitation program at the Hot Springs Rehabilitation Center.
7. To compare those SCI clients who successfully complete their vocational training programs with those clients who did not for the purpose of isolating client characteristics which are predictive of success.
8. To devise specific intervention strategies to meet the research defined needs of the SCI.

9. To complete a comprehensive review of psychosocial and vocational research pertaining to the SCI.
10. To measure the non-economic and quasi-economic contributions of the SCI to society.
11. To assess SCI clients' degree of satisfaction with rehabilitation services.

METHODOLOGY: The research design for measuring and monitoring client variables considers assessing the client's economic, environmental, social, and psychological status from entry into the project, through treatment, to project completion. A "repeated measures" design will be used and comparisons of SCI project clients to several other SCI client groups will be made.

FINDINGS TO DATE: The following implications appear from the currently completed data analyses.

1. Injured at or before 18, many clients have been in a dependent status for a significant period of time and have developed few vocational commitments and behaviors.
2. Most SCI clients viewed rehabilitation as access to medical and surgical services.
3. Diversity of goals selected by SCI clients underscores the need for individualized planning with clients; independence goals are somewhat more important to clients than vocational or social goals.
4. Like other disabled client groups, project clients reported low satisfaction levels of work, psychological, and health related needs.
5. Direct counseling with clients regarding their goals and objectives for the future is also required.
6. Psychological adjustment to spinal cord injury is highly idiosyncratic.
7. Project procedures for identifying and involving spinal cord injured individuals in rehabilitation services appeared effective.

APPLICABILITY: Results of this project should improve services to SCI clients at the HSRC and other comprehensive rehabilitation facilities.

161 Development and Evaluation of an Interpersonal Skills Training Package

Principal Investigator:	**Robert L. Akridge, Ed.D.**	
Status:	**Continuing**	
Dates:	**February 1975–February 1979**	
Cost:	**Annual $15, 705** **RT Annual $9,832**	**Projected Total $73,000** **RT % of Annual Total 63%**
Annual Report Reference:	**# 13, Page 13, R-136**	

OBJECTIVES:

Phase I

1. To determine inter-rater reliability of the following measures: a) Counselor Facilitation Scale, b) Client Self-Directive Behavior Scale, c) Client Self-Revealing Scale, and d) Client Internalization/Externalization Scale.
2. To study the relationship between ratings on these measures and client outcome in terms of status at closure.
3. To compare the relationship of the above measures with a comprehensive battery of psychological tests.

Phase II

1. To assess the impact of the IPS training package on client outcome, when used by VR counselors who have been trained by VR agency trainers.
2. To assess the impact of the IPS package on the interpersonal environment of a comprehensive VR center.

METHODOLOGY:

Phase I

1. Tape recorded counselor/client sessions will be rated (tapes already available in data bank).

2. Client closure status, R-300 data and client psychological test sub-scores are also available from the data bank.
3. Correlational analysis and multiple regression analysis will be used to analyze the data.

Phase II

1. Selected state agencies and rehabilitation centers will be asked to participate in the development of a comprehensive field test of the training program.
2. Clients of experimental group counselors (who will receive IPS training) and control group counselors (no IPS training) will be tracked with systematic assessment for a period of at least 2 years.
3. Specific data gathering procedures, instruments, and methods of analysis will be developed through consultation with participating rehabilitation agency personnel.

FINDINGS TO DATE:

1. Editorial and instructional design work on the IPS materials have been completed.
2. Developmental field tests have been conducted.
3. Phase I data collection and analysis have been completed.
4. A "second generation" trainer (trained by an RT-13 trainer) conducted an IPS experiment with nursing students. The experimental group nurses showed significantly higher skill levels on all criteria measures.
5. Plans are being completed to work through regional continuing education programs to conduct an evaluation of the IPS package in terms of whether counselors, trained by second generation trainers, influence client behavior to a comparable degree.

APPLICABILITY: The IPS training program purports to effect an improvement in basic counselor helping skills. With such training, counselors should be expected to achieve superior results in helping clients define and achieve goals and resolve problems.

162 Development and Evaluation of A Self-Instructional Physical Fitness Training Program for Spinal Cord Injured Rehabilitation Clients

Principal Investigator:	**G. Tim Milligan, MSE**	
Status:	**Continuing**	
Dates:	**October 1975–June 1978**	
Cost:	**Annual $7,238**	**Projected Total $20,000**
	RT Annual $4,528	**RT % of Annual Total 63%**
Annual Report Reference:	**# 13, Page 91, R-145**	

OBJECTIVES: To develop an individualized self-instructional physical fitness training program for use of rehabilitation clients with paraplegic involvement.

METHODOLOGY: Sample will consist of medically stable, spinal cord injured clients enrolled in vocational or pre-vocational training in a large rehabilitation facility.

New enrollees in the SCI recreation/fitness program will be evaluated to determine their physical functioning level. Following the fitness evaluation, clients will be given the self-instructional program to use as their fitness training curriculum. After two months, participating clients will be re-evaluated to determine progress.

Participating SCI clients will evaluate the program on the following criteria:

1. degree of assistance required to perform activities
2. value of the exercise (does it help?)
3. enjoyability of the exercise
4. probability of continued use of the program

FINDINGS TO DATE: A self-instructional program focusing on increasing user functioning, hygiene, diet, exercise and rest was developed and the materials reviewed by medical doctors, physical therapists, and recreation specialists in two rehabilitation facilities serving the severely disabled.

A test group of SCI paraplegics in a comprehensive rehabilitation center has been selected for the program. These clients will undergo a fitness assessment, be given the self-instructional program, and be re-assessed twelve weeks later.

Evaluation will be in terms of how many persons actually use the program and what fitness changes occur for those who do use the program compared to those who do not.

APPLICABILITY: This program should provide a physical fitness training program to increase the physical functioning level of SCI clients. Hopefully, it will result in a shorter rehabilitation time and decreased incidence of physical losses following termination of formal physical therapy services.

163 Rehabilitation Counseling: Development and Evaluation of a Comprehensive Counseling and Case Management Model

Principal Investigator:	**Stanford Rubin, Ed.D.**	
Status:	**Continuing**	
Dates:	**March 1976-February 1981**	
Cost:	**Annual $93,751** **RT Annual $58,486**	**Projected Total $480,000** **RT % of Annual Total 63%**
Annual Report Reference:	**# 13, Page 19, R-151**	

OBJECTIVES:

1. To identify effective rehabilitation counselor interview behavior.
2. To identify effective rehabilitation counseling non-interview actions.
3. To develop a case management handbook for rehabilitation counselors.
4. To prepare a series of training modules for teaching the skills identified in 1 and 2 above.
5. To develop instruments to assess the extent of counselor trainee skill acquisition.
6. To develop, disseminate, and evaluate self-instructional packages to train counselors to rate and classify counselor/client interaction.
7. To evaluate the completed training programs.
8. To revise and prepare a final training program based on results from the initial evaluations.
9. To prepare research reports on the effectiveness of the training programs.
10. To continue the refinement of the Facilitative Management Model of Rehabilitation Counseling through research.

METHODOLOGY: This project will be a coordinated effort involving several Center faculty. The methods to be used are similar for each of the major components of the model.

The general research methodology is as follows:

a. Development of Training Modules

The training modules will be developed to increase the trainees' awareness of different counselor skills and the effects they have on client behavior. Guidelines for the facilitative use of counselor skills will be presented. The training modules will include:

1. A didactic component which will be presented via lecture and modeling and will include:
    a. Definition of training module
    b. Rationale for the training module
    c. Listing and definition of various counselor skills
    d. A listing of the principles for the effective use of each skill
2. A discrimination component designed to train counselors to discriminate between effective and ineffective skills. This will be done via modeling, role-playing, and listening to and critiqueing tapes.
3. An experiential component designed so that trainees will be provided the opportunity to practice the counselor skills via role-playing exercises.

b. Development of Assessment Devices

The following areas will be assessed:

1. Cognitive Gain: Tests will be developed to measure trainee comprehension of the concepts and principles presented in the training modules.
2. Skills Gain: The degree to which the trainees learn the skills advocated in the training modules will be determined via direct observation of their capability to emit the desired

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behaviors. Necessary rating scales will be developed.

3. Attitudinal Evaluation: An evaluation form will be developed to measure the trainee's satisfaction with the provided training.

c. Assessment of the Training Modules

In order to determine the effect of training, the following will be performed:

1. A random sample of rehabilitation counselors will be drawn and divided into an experimental (training) and control (no-training) group.
2. Knowledge of appropriate behavior and ability to emit such knowledge will be assessed prior to training.
3. The experimental group will receive the Facilitative Case Management Training.
4. The control group will receive no training.
5. Following completion of training the counselor trainees will be assessed to determine if any cognitive or behavioral development has occurred. Also the attitudinal evaluation described above will be administered to the experimental group.

FINDINGS TO DATE: Developmental work has been initiated in all training areas in this project:

Systematic Caseload Management Module—

This module is conducted within a management by objectives framework with emphasis on time management. The three functions to be performed within this framework are Interviewing, Case Processing and Non-client Interaction. Teaching the specific skills to carry out each individual case management task is the function of the four subsequent modules.

Communication Skills Module—

The need for training in this area has been confirmed through an evaluation of the basic FCM training package. Two drafts of the didactic component of the module have been developed and further revision is taking place. Developmental work continues on the discrimination and experimental components and assessment devices for this module.

Information Exchange Effectiveness Module—

An initial rough draft of the didactic component of this training module has been completed and a revision is in process. Work has begun on development of the exercises for the discrimination component; the specific design of the experiential component is currently being developed; and tentative assessment devices have been developed and pilot tested.

Goal Setting Module—

This module contains two sub-sections. They are information processing training and goal setting interview training. Each sub-section contains didactic discrimination and experiential components.

1. Information Processing Training. An initial rough draft of the didactic component of this subsection is near completion. It contains guidelines for information collection during the intake interview. An outline of exercises for the discrimination component has been developed. The development of cognitive and behavioral skill gain assessment instruments has been initiated.
2. Goal Setting Interview Training. An initial rough draft of the didactic component of this subsection is near completion. An outline of the exercises contained in the discrimination component has been developed. The specific design of the experiential component is currently being developed; and the development of assessment instruments has been initiated.

Case Processing and Non-Client Interaction—

An initial rough draft of the didactic component is underway. The case processing functions have been identified and categorized. Discrimination and experiential components are in the process of development; skill gain assessment instruments are being prepared.

Comprehensive Evaluation of Basic Facilitative Case Management Package—

In addition to the activity listed under the five specific training areas of this project, an evaluation of the basic FCM training was conducted to assess its effectiveness and to determine areas of improvement for the present project. The following general significant findings resulted:

FCM training has a positive impact on the following dependent variables.

a. knowledge about basic principles and concepts of effective case management procedures
b. knowledge about how to distinguish a facilitative response from a non-facilitative response
c. knowledge about how to distinguish between the effect of different moment-to-moment interaction techniques
d. overall cognitive gain
e. counselors' general feelings and attitudes toward FCM training

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f. counselors' feelings and attitudes toward the value, appropriateness and practicality of FCM training
g. counselors' feelings and attitudes toward the organization, content and balance of activities in FCM training
h. counselor information collection behavior
i. counselor information dissemination behavior
j. counselor ability to communicate empathic understanding

FCM training had no impact on counselor moment-to-moment response style.

Although the basic FCM training package has a positive effect on counselor behavior, a need exists for greater in-depth training in FCM. Counselors in the experimental groups demonstrated significant gain in most areas; but improvement is needed if they are to reach appropriate levels of performance.

Case Management Handbook—

Preliminary work has begun on the case management handbook. This guide will emphasize the essential elements of managing individual cases whereas the caseload management component will emphasize the management of the entire caseload.

Counseling Process Scales Training Packages—

Process oriented assessment procedures and instruments have been developed as follows:

a. scales to assess counselor behavior
b. scales, inventories and observational guides to assess client functioning
c. psychosocial assessment process (programs)

These instruments, with supporting material, have been submitted to the media section for development of a self-instructional tape-slide-workbook training package.

Eight publications which relate to the development of the FCM Training package have been completed.

APPLICABILITY: The rehabilitation counselor remains as the principal client representative of the vocational rehabilitation system. However, the optimal counselor role model for serving the severely handicapped has not been adequately defined. The Facilitative Case Management model based on an integration of counseling and case management skills provides a reality oriented approach for rehabilitation counselors which has the potential to maximize the counselors' positive impact on clients.

164 Systematic Psychosocial Vocational Treatment Strategies in Vocational Rehabilitation Settings Serving Severely Disabled

Principal Investigator: **Robert Akridge, Ed.D.**
Status: **Continuing**
Dates: **March 1976–February 1981**
Cost: **Annual $126,661** **Projected Total $600,000**
RT Annual $79,237 **RT % of Annual Total 63%**
Annual Report Reference: **#13, Page 96, R-152**

OBJECTIVES:

1. To identify psychosocial-vocational problems experienced by the severely disabled
2. To clarify aspects of the problem requiring remediation; e.g., person, antecedent, or consequence variables
3. To select an appropriate mode and method of psychosocial-vocational treatment
4. To develop psychosocial-vocational treatment strategies to problems in living experienced by the severely disabled.
5. To evaluate the psychosocial and vocational gains resulting from treatment
6. To develop methods for maintaining treatment gains in the client's real life setting

METHODOLOGY: The systematic psychosocial-vocational treatment project is a coordinated effort involving several center faculty. The objectives and methodology of the component research projects vary depending upon the topic for investigation.

The general research methodology for each of these investigations is presented below:

Client Motivation in Rehabilitation. This investigation will include the following activities: a) review of the experimental and theoretical literature pertaining to client motivation; b) preliminary analyses of objective test data, including several motivational variables; c) a programmatic investigation of the motivational dynamics of rehabilitation clients in selected field offices and facilities; d) preparation of an instructional manual for rehabilitation counselors entitled "Understanding Unmotivated Clients."

A preliminary review of the literature indicates that there are several variables or specific measures relevant to this investigation: self-concept or self-esteem, as measured by the Tennessee Self-Concept Scale or Coopersmith Inventory; internal-external locus of control; need for achievement, as measured by TAT Protocols; level of aspiration; and Cattell's Motivational Analysis Test. After completing selected analyses, a comprehensive battery of tests and measures will be selected for use in the programmatic investigation of motivation. The design will include counselor assessment of client demographic and psychological variables relevant to motivation. Experimental studies will be conducted to supplement the primary multivariate-correlational investigation.

Counselor and Client Viewpoints on Rehabilitation Issues. Recent research (Leviton, 1973) suggests that success and failure in rehabilitation may be a function of counselor/client agreement (or disagreement) on seven philosophical issues: a) client participation versus emotional neutrality; 3) hopeful versus realistic approaches; 4) preferential treatment for promising patients versus equal consideration for all; 5) promoting independence versus allowing some independence; 6) safety versus some risk-taking; and 7) full disclosure of an invisible handicap versus hiding it whenever possible.

This project seeks to 1) develop self-report measures for each of the seven issues and assemble normative data for counselors and clients; 2) examine the relationships among counselor and client value positions on viewpoints and various counselor and client characteristics; and 3) examine the relationship between the extent of counselor/client agreement on the seven issues and other aspects of the counseling relationship including measures of rehabilitation success. Instrument development will proceed following the standard recommended steps. Collection of normative data and conduct of research to meet the second and third objectives will involve various district offices of the Arkansas Rehabilitation Services.

Client Perceptions of the Service Delivery Systems of a Comprehensive Rehabilitation Center. This investigation will be conducted to identify problems that rehabilitation clients face in a comprehensive rehabilitation facility; to chart changes in the psychosocial development levels of clients during their facility tenure; to measure client perceptions of the facility's environment and client satisfaction with facility experiences in their facility programs will be conducted at the Hot Springs Rehabilitation center.

In response to the four principal objectives of the project, data will be gathered from rehabilitation clients on the following instruments: Analysis of Behavioral Competence, Psychosocial Development Matrix, Moos' Community Oriented Programs and Environment Scale, and a Client Satisfaction Service Rating Measure. Data pertinent to the objectives of the study will be collected from clients at different stages of tenure in the center. The longitudinal cross-sectional design provides estimates of the changes on key variables which occur over time at the center.

After the identification of student problems, the second phase of the study involves presentation of the data in terms of management implications for possible changes in center programming. The third phase of the study calls for a second administration of the Behavioral Competence, Psychosocial Development, Social Climate, and Client Satisfaction measures to assess the effects of changes in center policy and practice.

Development of a Rehabilitation Psychosocial Model. This investigation will be conducted to 1) develop a functional rehabilitation psychosocial treatment model; 2) identify the stages of psychosocial growth; 3) identify skills and supporting knowledge rehabilitation workers need to facilitate client movement through the psychosocial growth process; 4) identify existing and needed programs and techniques which facilitate the psychosocial growth process; and 5) identify methods of evaluating the psychosocial growth process.

The ARR&TC has had an active history in the development of psychosocial techniques for rehabilitation. Previous research, as well as ongoing studies, provides the basis for this comprehensive model.

Psychosocial Treatment Procedures in a Rehabilitation Field Office. This project will be conducted to: 1) develop an overall psychosocial treatment strategy in rehabilitation field offices; 2) publish the strategy in terms of guidelines appropriate for any field office serving non-rural populations; 3) develop procedures whereby Personal Achievement Skills training can be provided as an ongoing aspect of the field office services; 4) integrate and coordinate the client's psychosocial growth resulting from Personal Achievement Skills training and Behavior Analysis Training with the counselor's efforts; 5) integrate RT-13 psychosocial treatment strategies such as Behavioral Skills Training, Handbook of Behavioral Management, etc., into individual and group approaches to psychosocial treatment; 6) identify other resources which might contribute to the effectiveness of field office programs in meeting client psychosocial needs; and 7) evaluate the training programs' effects on client outcome and staff behavior.

In testing this approach in a field office, the initial step will be to win the staff's acceptance of and support for development of a model program of psychosocial adjustment in their field office setting. Throughout the development of the program, the staff would be continually involved in defining and evaluating the effects and feasibility of program modifications.

The first innovation will be that of initiating the Personal Achievement Skills program for all feasible clients served by an office. Counselors will then be instructed in the use of Behavior Analysis Training and other selected techniques for individual interaction with clients. An approach to case staffing drawing on insights from the psychosocial treatment program will also be tested. As the basic concept of coordinated individual and group psychosocial services is implemented, other existing programs and techniques will be reviewed by the staff for possible inclusion in the program. Throughout the process, pre and post assessment of clients processed through the office will be completed. Staff attitudes will also be monitored. Guidelines for implementing this model will be developed and disseminated in a report containing research findings related to direct client outcomes and staff reactions.

Development and Evaluation of an "Understanding Human Behavior" Training Package. This investigation will be conducted to develop 1) a method for analyzing client behavior; 2) a method for viewing maladaptive behavior which suggests intervention strategies; 3) a method for viewing the process of movement from maladaptive to adaptive behavior patterns which suggests appropriate methods of interaction; 4) a method for viewing maladaptive behavior in terms of skill deficits; and 5) a method for conceptualizing the interaction between the person and prevailing systems. The resulting material will be integrated into an effective training program to be utilized by rehabilitation trainers. Evaluations of the effects of the training will be conducted. Based on the training experiences, existing materials of the Arkansas Rehabilitation Research and Training Center will be further developed and modified. The revised materials will be tested on seven groups of rehabilitation personnel, and feedback from these groups will serve as a basis for modification of the training program.

Development and Evaluation of a Program to Utilize Clients as Peer-Helpers in a Comprehensive Rehabilitation Center. This investigation will be conducted to 1) develop a training program to increase the interpersonal effectiveness of student leaders in a comprehensive rehabilitation center; 2) provide the training to selected student leaders in a comprehensive rehabilitation center to enable them to serve as effective helpers; and 3) evaluate the effectiveness of the training. The effectiveness of the training will be evaluated by measuring trainee improvement on a measure of facilitation, comparing the behavioral problems of the student before and after training, measuring student satisfaction with the help received from peer leaders, and training facility staff to conduct the training should they so desire.

Behavior Analysis Training: A Developmental Program. The foundation for Behavior Analysis Training can be found in the current Personal Achievement Skills training program conducted by the Arkansas Rehabilitation Research and Training Center. The experiences that have been gained in Personal Achievement Skills training have already been applied to the development of the central ideas of Behavior Analysis Training.

With the development of a preliminary set of materials for Behavior Analysis Training, personal adjustment counselors at the Hot Springs Rehabilitation Center and elsewhere will pilot test the materials with several clients. Based on feedback from field tests a revised version of the training package will be developed.

Development and Evaluation of a Set of Systematic Training Units to Increase or Decrease Selected Client Behaviors (Behavior Skills Training). Particular target behaviors will be identified, then professional literature examined for existing programs which could be modified or strengthened to increase or decrease those behaviors. The following procedure will be used in developing each of the systematic training units: (1) define the behavioral dimension in operational terms—(2) design training activities and materials—(3) test with rehabilitation clients (video tape base level performance, treatment, and post-treatment performance)—(4) make program revisions—(5) retest—(6) repeat steps 4 and 5 until treatment consistently produces the desired level of post-training performance.

Psychosocial and Service Outcome Correlates of Acceptance of Disability. Clients with physical disabilities currently enrolled at the Hot Springs Rehabilitation Center have been contacted to participate in the study. Students in the projected sample will complete a biographical form and several instruments, e.g., Cantril's Life Ladder, Rokeach's Value Survey, and Linkowski's Acceptance of Disability Scale. Other demographic and center outcome data will be secured from the client's file at the Center. These data will be used to (1) compare the value systems of two groups of clients—disability accepters and nonaccepters (2) to examine the life outlook and goals of accepters and nonaccepters, (3) to relate acceptance of disability to center outcome, (4) to determine counseling uses of a brief measure of life outlook as it pertains to acceptance of disability and value patterns, and (5) to explore the application for the physically disabled of Rokeach's approach to value counseling.

FINDINGS TO DATE: A brief progress report is provided under each component title.

Client Motivation in Rehabilitation (Motivation Dynamics of Disadvantaged Female Clients). The primary findings of the investigation were (1) In comparison to population norms—the disadvantaged females sample exhibited lower self-esteem and less general motivation. They were less tense and suspicious, and more conscientious, sensitive and liberal. Their work motivation was comparable to that of welfare clients in another project. (2) Subgroup differences on the inventory scales and interview variables indicated that blacks and subjects with lower IQs and less education were less motivated, had lower self concepts, and were more externally oriented. (3) Factor analysis of the psychometric battery produced 12 broad dimensions of client motivational structure, with most of the factors being instrument-specific. Factor analyses of the value and activity data from the structured interview produced parsimonious descriptions of these domains. (4) Correlational analyses which assessed the relationships between inventoried motivational characteristics and values and activities resulted in few relationships of substantial magnitude. One exception, which is consistent with the subgroup differences noted previously, is that race and IQ were significantly correlated with several motivational and value dimensions.

Counselor and Client Viewpoints on Rehabilitation Issues. Developmental work continues on this project.

Client Perceptions of the Service Delivery Systems of a Comprehensive Rehabilitation Center. Analysis of data at this point covers the areas of Center environment, service satisfaction, and student problems. Student perceptions regarding different aspects of Center life and services are: **Center environment**—Based on results from the Community Oriented Program and Environment Scale (COPES), comparisons of student real-ideal perceptions of the Center environment revealed that the students wished the environment to move to considerably higher levels on the relationship dimensions (more student involvement in the program, more staff support for students and student support for each other, and more free and open expression within all relationships) and to more order, organization, and program clarity. Students enrolled for a relatively short time, the new students, perceived the environment in the same way as students enrolled for an average of four months, the experienced students. Both new and experienced students' real perceptions remained the same from one interviewing phase to another.

Satisfaction with services—Students rated the various Center services which they had received and then reported the outstanding characteristics and recommendations for improvements for each service. On the average, students were satisfied with the various services. Only two of the twenty services (physicians' services and placement) were rated on the average below the midpoint on the seven point scale.

Student problems—Overall, student problem data revealed more problems and more consensus regarding problem areas in the initial interview than in the follow-up interview. Problems with other students, regulations, medical services, and detrimental staff attitudes were some of the most pressing issues mentioned in the initial interview. Similar concerns were noted in the follow-up interview with one exception; fewer medical problems were mentioned.

Development of a Rehabilitation Psychosocial Model.

Publications describing the present form of the model are,

Means, B. and Akridge, R. "Psychological and Behavioral Adjustment: A Model of Healthy Personing," submitted to **Journal of Rehabilitation**

Akridge, R. "Modeling the Rehabilitation Process," submitted to **Rehabilitation Counseling Bulletin.**

The model provides an organizational scheme for developing a series of instructor-assisted training packages for VR clients which increase beliefs, values, and skills associated with healthy personing. Training packages in process are Communications Training, Self-control Training and Value-clarification Training.

Psychosocial Treatment Procedures in a Rehabilitation Field Office. Developmental work continues on this project.

Development and Evaluation of an "Understanding Human Behavior" Training Package. Three field tests of the program have been conducted, and the program is currently being revised as a result of subsequent feedback. Three additional field tests of the program are planned during the next reporting period.

Development and Evaluation of a Program to Utilize Clients as Peer-Helpers in a Comprehensive Rehabilitation Center. A group of student leaders in a comprehensive rehabilitation center was identified and given modified Interpersonal Skills Training (IPS). Measures of facilitation were taken on a pre/post basis. One student was selected from this training group and is currently conducting IPS training with a group of peers. The initial training group showed marked improvement in IPS as measured by a facilitation scale.

Behavior Analysis Training: A Developmental Program. The completed version of the counselor's manual for Behavior Analysis Training (BAT) is divided into ten sections—(1) Introduction (2) Philosophy and Model (3) Problem Identification (4) Problem Definition (5) Readiness for Change (6) Resolution Behaviors (7) Incentives (8) Programming (9) Monitoring, and (10) Termination. Sections 1 and 2 present basic theoretical rationale of a behavior-in-situation approach to personal adjustment training. Section 3 moves the client and counselor into identification of problem behaviors in vocational and social areas. During section 4 client and counselor complete behavior analyses or contextual analyses of the problems. Phase 5 focuses on whether the client is really ready to make a change. In the 6th phase, client and counselor complete and discuss additional activities aimed at clarifying what the client can do behaviorally to resolve current vocational and social problems. Section 7 involves the client in identifying desirable things to do or have. Section 8 focuses on the development of a behavioral plan that outlines more effective responses to social and vocational problem situations. Section 9 (monitoring) is introduced with the completion and discussion of the goal attainment worksheet. At termination (section 10), the counselor determines the extent to which the client knows and uses the skills in BAT. To encourage further use of the skills, the client completes a final five things list which indicates additional goals to accomplish using the skills of BAT.

Development and Evaluation of a Set of Systematic Training Units to Increase or Decrease Selected Client Behaviors (Behavior Skills Training). Behavior Skills Training was conducted with about 50 HSRC clients. Regardless of the source and reasons for referral and of the primary and secondary disabilities used to qualify clients for services, a relatively small number of life-skills deficits were found to be common among this set of clients. The most common skill deficits tend to cluster around Communications Training, Self-Control Training, Value-Clarification Skills Training, and Achievement Skills Training. Instructor assisted training packages are being developed for VR clients which address the above areas.

Psychosocial and Service Outcome Correlates of Acceptance of Disability. Preliminary steps toward completing data collection for the project have been taken.

APPLICABILITY: This project holds considerable promise for the resolution of major adjustment problems in rehabilitation. Activities include studies of problem identification, treatment programs for problem behaviors, and increasing life-adjustment/life-planning skills.

165 Program Evaluation Techniques in Vocational Rehabilitation Agencies and Facilities: The Assessment of Rehabilitation Process and Outcome

Principal Investigator:	**Paul Cooper, M.S.**	
Status:	**Continuing**	
Dates:	**March 1976-February 1981**	
Cost:	**Annual $80,116** **RT Annual $44,939**	**Projected Total $370,000** **RT % of Annual Total 56%**
Annual Report Reference:	**# 13, Page 188, R-153**	

OBJECTIVES:

1. The identification and/or development of outcome technology.
2. The utilization of outcome technology.
3. The identification and/or development of process technology.

4. The utilization of process technology.

METHODOLOGY: The methodology used in this project may be classified into five types of activities.

1. Identification: This research technique includes literature reviews and searches for appropriate measures and methods.
2. Development: This activity includes the development of needed instrumentation and technology.
3. Adaptation: This activity includes the adaptation and implementation of evaluation measures to specific situations such as center training efforts or individual rehabilitation facilities.
4. Utilization: This activity may include the utilization of outcome and process technology in an evaluation or field study setting.
5. Analysis: This activity includes the statistical analysis and interpretation of data collected as part of the project as well as the estimation of instrument parameters such as norms or reliability.

FINDINGS TO DATE: **The Development of a Model for the Analysis of Case Movement in a Vocational Rehabilitation System.** Data collection completed. A preliminary definition of an elementary case movement model has been developed. Although this model was based on incomplete data, the basic approach has proven to be feasible and subsequent analysis will determine its reliability and utility.

An Analysis of the Effectiveness and Efficiency of a Comprehensive Rehabilitation Center Evaluation Unit. The purpose of Phase I research (Cook, 1977) was to obtain baseline information, amendable to future trend analysis, on the process and outcomes of Center services. A specific concern was to analyze the effectiveness and efficiency of evaluation unit recommendations for client services. The procedure was **post hoc** in nature whereby a random sample of 100 clients exposed to the Hot Springs Rehabilitation Center, Hot Springs, Arkansas, during 1974 was selected and analyzed in respect to certain Center procedures and eventual rehabilitation outcome. Analysis consisted of descriptive and nonparametric statistics, no cause and effect relationships are implied and generalizations must await further trend analysis.

Some of the more significant findings are as follows:

a. The evaluation unit at the Hot Springs Rehabilitation Center makes one of four possible recommendations drawing on medical, psycho-social and vocational evaluation data obtained over a two week client evaluation period. The percentage of persons recommended by category were: 30% to direct vocational training, 39% to long term evaluation, 14% to work adjustment training and 15% to immediate discharge. These recommendations paralleled the percentage of recommendations given trainees during 1971-1973.

b. Evaluation unit recommendations were closely followed by actual Center disposition or first assignment.

c. Persons who received Center services (N=85) were divided into three outcome groups: Center program completers (N=16), voluntary dropouts (N=44) and other non-completers (disciplinary discharges during training, transfers, etc. N=15).

d. R-300 information was available for 95 persons. Regardless of Center outcome, about one third of these persons were closed rehabilitated approximately three years after referral to the Center. About a third had been closed ineligible for rehabilitation services or as unsuccessfully rehabilitated. One third were still in active status.

e. Relative to the other Center outcome groups, program completers had the largest percentage of still active cases. Comparing the number of persons closed rehabilitated or not rehabilitated by Center outcome group there was a significant positive relationship between Center program completion and being closed rehabilitated.

f. Program completers spent a significantly longer average time at the Center than did program noncompleters.

g. Center program completers closed rehabilitated and in competitive employment had nominal but not significantly higher weekly salaries than Center noncompleters who were employed.

h. For persons closed rehabilitated, there was a 26% match between type of job held and type of Center training.

i. Only two of the fifteen persons exposed to work adjustment training completed a Center program of vocational training. Five of the fifteen were eventually closed as successfully rehabilitated.

j. No significant relationship between type of evaluation recommendation and Center program completion was found.

k. Persons recommended to long term evaluation had a 37% chance of program completion, persons recommended to direct vocational training had a 29% chance of program completion and persons recommended to work adjustment training had less than a 10% chance of program completion.

l. Successful rehabilitation closures (status "26") were evenly split between persons recommended to long term evaluation and direct training and evenly split between persons recommended for discharge and work adjustment training.

m. Analysis of theoretical expected Center outcome revealed that recommendation into direct vocational training was the least efficient recommendation. Whether or not referral to work adjustment training was an effective recommendation or the basis for a self-fulfilling prophecy could not be ascertained.

An Assessment of the Relationship Between Client Outcome as Measured by Client Outcome Rating Procedures and Other Outcome Variables. Both Arkansas and Oklahoma data were analyzed and the results of the analyses reported to the program evaluation specialists in each state. Although strong relationships were indicated between outcome as indicated by the rating forms and closure status, the questionable reliability of the rating form data precluded meaningful inferences with respect to agency operation. Despite these difficulties, much valuable experience was gained relative to the design, implementation and utilization of outcome measurement systems.

An Investigation of the Reliability of the Arkansas Facility Outcome Measure Rating Form. Analysis was completed on the sample of cases for whom Admittance, Intermediate, and Discharge ratings were obtained and Reliability estimates were computed. The results may be summarized in four significant findings:

a. The reliability of the Arkansas Facility Outcome Measure rating form was found to be unacceptable for ratings made at admission to the facility. Intermediate ratings made six weeks following admission were also questionable.

b. Despite the questionable reliability it was clear that mean ratings for the clients in the study consistently increased from Admission to Intermediate and from Intermediate to Discharge with respect to Vocational Functioning, Vocational Maturity and Interpersonal Maturity.

c. The internal consistency estimates for each of the three dimensions—Vocational Maturity, Vocational Functioning, and Interpersonal Maturity—were high.

d. The three dimensions were highly intercorrelated indicating a possible "halo" effect and questionable validity of the instrument dimensions.

An Investigation of the Results of the Annual Review of Ineligibles and Nonrehabilitants. This project originated as the result of a direct request from the state directors of HEW Region VI. Research data collection instruments have been developed and distributed to the participating agencies.

A Study of the Feasibility of a Weighted Case Closure System in a Vocational Rehabilitation Agency. A grant proposal has been written and submitted to RSA/OHD to secure additional funding for this activity. As part of the grant proposal a preliminary literature review has been completed and a detailed work plan developed.

An Eight Year Follow-up Study of Arkansas "Client-Counselor Interaction Project" Clients. This project is in the beginning stages. Agreements have been executed with the Director of the Arkansas Division of Rehabilitation Services and the local office supervisor where the study is based. Data collection will begin as soon as final arrangements can be made.

Evaluation of the RIDAC (Rehabilitation Initial Diagnosis and Assessment for Clients) Project for the Arkansas Rehabilitation Services. Every RIDAC Project which is funded by RSA is required to evaluate the extent to which the Project objectives are achieved. The evaluation plan for the Arkansas RIDAC unit includes three areas of assessment: (a) impact on clients, (b) usefulness to counselors, and (c) effectiveness of the unit. Each area is briefly described below with preliminary data summarized where possible.

a. During the first nine months of operation the RIDAC unit evaluated 439 clients, of whom one half were categorized as severely disabled. Less than 20% of the clients were closed in 08 status and the average number of days between referral to the agency and acceptance or 08 closure was approximately 30 days. Only two days were required to complete the typical RIDAC evaluation. The volume of RIDAC services is indicated by the number of evaluations conducted: medical (318), psychological (272) and vocational (203).

b. After more than six months experience using the RIDAC unit, counselor opinions were generally highly favorable. Counselor feedback resulted in the addition of a psychiatric consultant to the RIDAC unit.

c. The effectiveness of the RIDAC unit will be assessed by comparing the outcomes for the RIDAC-evaluated clients with a matched sample of clients served during previous years. Our primary goals for the next two years are to refine the RIDAC operation to formulate principles of evaluation which maximize the usefulness and effectiveness of RIDAC reports and recommendations and to develop guidelines for establishing RIDAC units in other offices.

Eighteen Publications and/or presentations have been generated by this major effort in Program Evaluation.

APPLICABILITY: This project is planned to focus initial effort on the continuing assessment of rehabilitation outcome along relevant dimensions compatible with the objectives of rehabilitation agencies and projects, the prediction of case flow within the rehabilitation system, the assessment of client gain realized through psychosocial-vocational adjustment programs, and the measurement of the effects of rehabilitation counseling.

166 The Identification of Factors Affecting Behavioral Competency in a Comprehensive Rehabilitation Center

Principal Investigator:	**John Marr, Ph.D.**	
Status:	**Continuing**	
Dates:	**August 1976–December 1977**	
Cost:	**Annual $27,643** **RT Annual $17,293**	**Projected Total $34,000** **RT % of Annual Total 63%**
Annual Report Reference:	**# 13, Page 212, R-154**	

OBJECTIVES:

1. To identify problems in each service area of the rehabilitation facility.
2. To identify factors which restrict staff in their attempts to cope with the problems.
3. To analyze the problems and factors in terms of relative importance and possibility of resolution.
4. Prepare reports for facility administrators on recommendations and strategies for resolving the behavioral problems.

METHODOLOGY: All sections (except maintenance) of the facility staff will be surveyed in an effort to determine a) the extent to which each service facilitates effective operation of the Center, and b) extent to which each service contributes to the final objective of the center – preparing the client for employment.

A survey will also be made of a) a sample of field counselors who have referred clients to the Center, to determine their objectives for service delivery when referral was made, and b) field counselors with recently graduated or terminated clients, to determine their satisfaction with the Center's delivery of services.

Analysis procedures will be developed following identification of various types of data collected.

FINDINGS TO DATE: Data collection has been completed. Parts I and II of the final report have been prepared for distribution to all Center staff. Findings of the study indicate that the behavior approach of administering a social climate scale and interviewing clients, staff and students yields a comprehensive picture of service delivery which allows administrators and supervisors to assess general morale, strengths and weaknesses of various service sections, and also pinpoints specific changes which need to be made. Further analyses of the relationships among measures should allow statements about the utilization of the measures to examine service delivery in other rehabilitation facilities. In addition, the results should reveal characteristic responses which clients and staff make to various problems experienced in receiving and delivering services.

APPLICABILITY: This project is viewed as an applied, action research study to determine factors which affect the efficiency and effectiveness of a comprehensive rehabilitation facility. The possibilities for generalization will be limited by the uniqueness of the facility to some extent. However, the results should have some application to similar facilities.

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University of West Virginia (RT-15)
Vocational Rehabilitation Research and Training Center

CORE AREAS OF RESEARCH DISSEMINATION/TRAINING

Program Evaluation

Techniques and strategies to improve the capacity of vocational rehabilitation in program assessment and evaluation, and data management and utilization to increase the effectiveness of the rehabilitation program in meeting the needs of those it serves.

Improved Service Models

Investigating various aspects of the vocational rehabilitation system with the aim of providing information and models which will permit rehabilitation to increase the effectiveness of its services and service delivery system.

Programmatic Barriers to Vocational Rehabilitation

Identification and assessment of all types of program barriers to vocational rehabilitation at all levels, e.g., state and national.

Affirmative Action and Consumer Involvement

Strategies and techniques for enabling vocational rehabilitation of handicapped individuals for maximizing the impact of legislation leading toward total integration of handicapped into the world of work.

Institute on Rehabilitation Issues

The study of significant issues of concern to the rehabilitation community.

UNIVERSITY OF WEST VIRGINIA

Joseph B. Moriarty, Ph.D., Director
University of West Virginia Vocational
Rehabilitation Research and Training Center
Institute, West Virginia 25112

PROJECT TITLES BY FY 1978 STATUS

	ABSTRACT NO.
COMPLETED	
Toward A Placement System Empirically Established Through Criterion-Group Method: Self-Employment for the Severely Handicapped (M. S. Tseng, Ed.D.)	167
Simplified Model for Cost-Benefit Analysis in Rehabilitation Programs (R. K. Majumder, Ph.D.)	168
CONTINUING	
Program Evaluation and Planning (Tools for Rehabilitation) (R. T. Walls, Ph.D.)	169
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Negative Incentives: Contingencies Which Discourage Disabled Individuals From Seeking or Completing Rehabilitation Services and Subsequent Employment (R. T. Walls, Ph.D.)	171
Development of a Valid Multiple-Factor Instrument to Assess Severity of Handicap (R. Hartnett)	172
NEW	
Factors Influencing Work Adjustment of Disabled Workers (M. S. Tseng, Ed.D.)	173
PROPOSED	
A Field-Based Microcomputer Assisted Vocational Rehabilitation Counseling System	
Developing a Model for Statewide Study on Ineligible Cases (08)	
A National Study of Trends and Characteristics of Closed VR Cases as a Function of National Priority on the Severely Disabled	

167 Toward A Placement System Empirically Established Through Criterion-Group Method: Self-Employment for the Severely Handicapped

Principal Investigator:	**M. S. Tseng, Ed.D.**	
Status:	**Completed**	
Dates:	**January 1974-July 1977**	
Cost:	**Annual $25,982** **RT Annual $23,900**	**Projected Total $71,700** **RT % of Annual Total 90%**
Annual Report Reference:	**#12, Page 42, R-29**	

OBJECTIVES:

1. To sort out (using guidelines for the Self Employment Program, WVa Division of Vocational Rehabilitation Manual), through the criterion-group method, from a list of personal attributes, those which would characterize severely disabled persons who are successful in self-employment settings;
2. to determine the personal characteristics profile of the clients at the time of placing them in self-employment projects; and
3. to validate this placement system by following up these clients for a reasonably long enough period of time.

METHODOLOGY:

1. Two sample groups are examined. The first sample consists of successfully and unsuccessfully self-employed former vocational rehabilitation clients. The second sample consists of clients who are being closed in Status 26 as the self-employed cases.
2. Forty personal attributes (including intelligence, attitudes, and various personality factors) are measured in all of the clients. Paper-and-pencil questionnaires (SBE, SEP), the Revised Beta Examination, the arithmetic section of the Wide Range Achievement Test, and the Sixteen Personality Factor Questionnaire Form C are administered to tap these variables.
3. Inferential statistics, including analyses of variance and Chi square analyses, and descriptive statistics, such as correlation and discriminant analysis, are carried out.

FINDINGS TO DATE:

1. Sample 1 data (33 successful and 20 unsuccessful cases) show that out of 40 personal attributes, 11 differentiate the successfully self-employed group from the unsuccessful group.
2. Of the 11 variables, these 9 yield metric data: self-acceptance, attitude toward work, perception of success, need for autonomy, attitude toward self-sufficiency, desire for profit, desire to be one's own boss, conservative-experimenting personality, and uncontrolled-controlled personality. A statistically significant discriminant equation has been formulated using these 9 client variables as predictors. This discriminant equation is capable of achieving 85.7% hit on the prediction of successfully self-employed clients.
3. Sample 2 data show that of a total of 35 clients who responded to the Self-Employment Project Questionnaire at the time each of these individuals was just entering into the self-employment setting, two were known to have died and two were no longer self-employed as of October 15, 1977.
4. Although we do not have enough cases for comparing the unsuccessful group with the successful group inferentially at this time, descriptively speaking the two subjects who quit their respective self-employment appeared to be on the average older (mean age 48.0 as compared to 41.8 for the total sample), less educated (mean education level 6.5 as compared to 10.0), less positive on the perception of human nature (mean score 11.5 as compared to 16.0), less self-accepting (mean score 8.5 as compared to 12.9), and lower in believing that powerful others (mean score 18.0 as compared to 22.0) or chance forces (mean score 14.5 as compared to 20.8) control them.

APPLICABILITY: This project provides those rehabilitation counselors, who are in the position to help severely disabled clients, with empirical data useful for carrying out job placement and job development activities, especially with respect to self-employment.

University of West Virginia

168 Simplified Model for Cost-Benefit Analysis in Rehabilitation Programs

Principal Investigator:	**Ranjit K. Majumber, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1974-September 1977**	
Cost:	**Annual $11,278**	**Projected Total $25,000**
	RT Annual $9,844	**RT % of Annual Total 78%**
Annual Report Reference:	**# 12, Page 58, R-32**	

OBJECTIVES:

1. To develop, apply, and test a procedure of benefit-cost analysis (economic gain or loss) to society from the VR program.
2. To develop a series of cross classified expected benefit-cost ratios through a procedure which predicts both the benefit and the cost stream (life-long benefits that accrue through intervention) from the characteristics of the rehabilitation potential (human capital) and other economic influences.
3. To check the accuracy of the predicted ratios against a second set of benefit-cost ratios developed from the actual earnings and cost experience of the sample of rehabilitants.
4. To suggest the appropriate data base and analyses strategies for VR agencies.

METHODOLOGY: Rehabilitation clients who were accepted in fiscal year 1971 in West Virginia (n=7,515) compose the population from which the study sample was drawn. The bulk of the data to be used in this study comes from the RSA-300 forms, the Case Service Reports of the Federal-State Program of Vocational Rehabilitation, containing a very complete record of the individual from date of acceptance to date of closure. Data on actual earnings was obtained from the WV State Income Tax Records. Since the VR process is being viewed as an investment in human capital, the size of the benefit stream can be expected to be influenced by such factors as the natural abilities of the client, the extent to which the disability affects the maximization of an individual's level of human capital, the number of disabilities and their severity, and various economic conditions to the individual.

A cross-classified analysis was made, also, involving these variables which were expected to have some differential effect: sex, age, education, location, and disability. In this study, a regression model was developed in which change in the earnings of the rehabilitant was the dependent variable and the above set of factors were included in the independent variables.

FINDINGS TO DATE: Results, during 1976, are for the overall program only. The results for the cross-classified population will be analyzed during 1977. The following findings and accomplishments are reported:

1. The results suggest that the VR program (in this instance) proves to be effective, from a benefit-cost analysis perspective.
2. The tax data applied to the overall results suggest that benefits are durable for at least four years.
3. The tax data also suggests that projections from the RSA-300 data are only slightly optimistic.
4. In addition to developing and testing of the general B/C ratio model, a Simplified Computational Worksheet with detailed instructions was prepared.
5. Benefit-cost are considered in the content of a) total income increase of the client, b) generating tax and reducing public assistance.

APPLICABILITY: The proposed model has the following applications to rehabilitation:

1. The proposed model should provide rehabilitation with a useful tool to check the efficiency and effectiveness of their program efforts. The prepared Simplified Computational Worksheet could possibly be utilized by VR program evaluators.
2. Simplified computational worksheet for B/C index could be used as an intra-program preliminary evaluation measure by the State Federal Rehabilitation Agency (e.g., B/C index for SSDI, SSI, Severely Disabled, etc.)

169 Program Evaluation and Planning (Tools for Rehabilitation)

Principal Investigator:	**Richard T. Walls, Ph.D.**	
Status:	**Continuing**	
Dates:	**March 1973-April 1979**	
Cost:	**Annual $17,298** **RT Annual $16,172**	**Projected Total $89,730** **RT % of Annual Total 92%**
Annual Report Reference:	**# 12, Page 17, R-24**	

OBJECTIVES: To develop a model for evaluation of rehabilitation services. (The research activity is attempting to show the extent to which coded R-300 data may be used to evaluate rehabilitation services.)

The major question is (a) what data elements or variables, (b) what data collection aids, and (c) what data reduction or display techniques will be of greatest value to VR agencies?

METHODOLOGY:

1. The project is examining the records of over 700,000 rehabilitation clients with all types of handicaps.
2. Various variables (demographic, educational, social, economic, disability, process, closure, cost-benefit, outcome, client rated) are being studied.
3. The variables are measured by means of the RSA-300 field counselor's standard report form.
4. Various portions of the project are using analysis of variance, chi square correlation, multiple regression and common sense.
5. A mark-sensing form is being developed that may be machine read that includes all R-300 variables as well as other helpful program evaluation data.
6. The Profile Analysis Technique is being further developed and field tested at National, State, District, and Counselor levels.

FINDINGS TO DATE: R-300 data taken from every client (N=14,569) was classified into data on 30 intake (or input) variables, 24 process (or intervention) variables, and 8 outcome (or output) variables. In order to identify meaningful relationships and interactions among variables across intake, process and outcome a bivariate and multivariate analysis of the R-300 data was conducted for the purpose of making certain references as well as determining the existing state of affairs in the rehabilitation process.

Intercorrelations among such variables as cost and time, cost and age, cost and earnings at closure, months from acceptance to successful closure, weekly earnings at closure and public assistance amount at closure, etc. were made. Norms on client characteristics enabling a counselor to see how their individual clients resemble at intake persons with similar major disabilities or referral sources and what the processes and outcomes can be expected were established.

Among more interesting findings to date are: 1) spending more time and money on a client is related to better outcome at closure in terms of earnings; 2) the longer a client is in status (referral states) 00-02 (applicant states) the less money will ultimately be spent on him; 3) clients with higher income at intake tend to have more money spent on them. Other similar findings are listed in the Progress Report.

a. During this year we worked with IBM representatives to mock up the Rehabilitation Reporting Record. Galley proofs were made, checked, and returned. A major portion of this time for the project staff involved checking all codes against RSA-300 codes to insure compatibility. Coordination with the Pittsburgh division of IBM led to composition meetings with staff of the IBM paper documents division in Greencastle, Indiana. After two revisions of galley proofs, 1000 copies of the prototype of the form were produced. In addition, the West Virginia Research and Training Center project and production staff worked together to produce a prototype manual (description, instructions, and supplementary codes).

b. Any variety of different variables might be represented on the Caseload Profile. For example, an agency might wish their counselors to have feedback on how many months their clients are staying in statuses 00-02 or how many dollars were spent on physical restoration compared to the state average. Several states are currently using some form of PAT.

APPLICABILITY:

a. The Rehabilitation Reporting Record has the potential to significantly affect rehabilitation policy on a state or national scale. Policies will not be advocated by the project team. The Rehabilitation Reporting Record is clearly not a RSA form. However, widespread exposure to these data elements and format may stimulate shifts in thinking and behavior when standards for program evaluation are proposed and when RSA or state requirements for data are reviewed or revised.

The Caseload Profile employs a device termed the profile analysis technique (PAT). There are five major guiding criteria in the development of this PAT mechanism. These were (a) orientation toward rehabilitation, (b) multiple criteria analysis, (c) flexibility, (d) simplicity in computation, and (e) ease of interpretation. The essential idea is that information routinely collected by state agencies may be used to compare an agency's, district's or individual's performance in a number of categories against a norm (e.g., national, state, or district average).

170 Analyzing Performance Competencies of Severely Handicapped Clients

Principal Investigator:	**Richard T. Walls, Ph.D.**	
Status:	**Continuing**	
Dates:	**May 1976-April 1979**	
Cost:	**Annual $12,467** **RT Annual $11,650**	**Projected Total $38,000** **RT % of Annual Total 92%**
Annual Report Reference:	**#12, Page 109, R-33**	

OBJECTIVES: There is a substantial number of vocational behavior checklists available and in use today throughout vocational settings. All of these propose target vocational skills for clients.

The major question is which of these skills are actually needed for adequate job functioning? What skills facilitiate job entry and job retention? Of all the separate skills (approximately 500) listed in checklists, which ones should be stressed in training, and which ones could be eliminated?

METHODOLOGY: The project team is presently in the process of constructing and refining the vocational skills matrix. As presently projected, it will list behaviors or competencies in 7 areas: (a) Job Related Skills, (b) On-the-Job Social Skills, (c) Union-Financial-Security Skills, (d) Interview Skills, (e) Job Seeking Skills, (f) Prevocational Skills, and (g) Work Performance Skills.

When this work is completed and the necessary liaison work has been done, a small number of clients will be selected. The training supervisors of these clients will indicate which skills they believe to be necessary for job acquisition and retention in that occupation. The client will be assessed at the end of training to determine which skills are present. Prior to placement in trial employment (if possible) the prospective employer of these clients will indicate which skills they believe necessary for job acquisition and retention in that occupation. Within a week of placement in trial employment, the client will be assessed to determine which skills are present. Finally, the client will again be assessed at the end of the 60 day trial employment period. An indication will also be obtained from the employer as to whether the client will be continued or not and the reasons for that decision.

FINDINGS TO DATE: From the literature review of 166 behavior checklists, 39 were found to contain items (behavior descriptions) related to prevocational, vocational, occupational, and work behaviors. These 39 were reviewed, categorized, and evaluated.

Vocational items from checklists were counted and sorted into these seven subclasses.

The project team is currently constructing the matrix for the experiment by eliminating duplicates and overlap in the items. Only vocational items from checklists with objectivity scores of 3, 4, or 5 are being included in the client-training supervisor-employer experimental matrix of skills.

APPLICABILITY: Results of the experiment and training based on the experiment should be of greatest benefit to training supervisors and VR counselors. The ultimate benefactor is the client. Comprehensive vocational skills assessment can help all parties to effective placement. Behavioral statements of skills are not as likely to be misinterpreted as scores on traits, constructs, rating scales, or global objectives.

Further, the findings of this project may be utilized by vocational rehabilitation personnel who must observe, evaluate, and improve client performance. Since vocational rehabilitation services address themselves to a wide variety of client activities, this project will provide a useful function in organizing available performance checklists in terms of activities relevant to getting and keeping a job.

171 Negative Incentives: Contingencies which Discourage Disabled Individuals from Seeking or Completing Rehabilitation Services and Subsequent Employment

Principal Investigator:	**Richard T. Walls, Ph.D.**	
Status:	**Continuing**	
Dates:	**May 1976-April 1979**	
Cost:	**Annual $26,750** **RT Annual $24,658**	**Projected Total $42,000** **RT % of Annual Total 92%**
Annual Report Reference:	**#12, Page 167, R-34**	

OBJECTIVES: The major question is which types and amounts of cash and in-kind benefits (at what benefit-loss rate) discourage eligible individuals from engaging in and completing VR services. Further, to what extent is this a problem in VR, and, if it is a substantial problem, what are some possible remediating actions?

METHODOLOGY: Subjects. The subjects will be approximately 300 VR clients of varying age, sex, and disabling condition. Of these 300 clients, some will be receiving some kinds of cash and/or in-kind benefits at referral to VR. The others will not be receiving benefits from any of the sources listed at referral.

Design. The design is a simple two group format. The clients receiving benefits at referral will be considered the experimental group and the clients not receiving benefits at referral will be considered the contrast or control group. The independent variable is, thus, benefits at referral versus no benefits at referral. Obviously, the amounts and types of benefits will vary markedly within the experimental group since no attempt to stratify the random sampling procedure will be attempted. This implies blocking on different patterns or clusters of disability, sex, age, or, most importantly, type and amount of benefits will probably aid in clarifying the findings. However, the major result will consist of a comparison of frequencies of successful closures for the experimental versus control group. Thus, the dependent variable is the closure status of the individuals. Factors associated with closure such as competitive employment, homemaker employment, earnings, etc. will also be considered. Chi Square analyses, simple frequencies or percentage tables would be appropriate ways of examining the data.

FINDINGS TO DATE: As noted previously, VR does have some information to serve as a reference (VR status 26) point. Presumably, some similar data could be reported for nonrehabilitated clients (VR status 28 or status 30), but at this writing, to our knowledge no such summaries of national VR data exist.

Further, the data are in aggregate form and may not be used for cross comparisons between VR outcome and total benefits on a casewise basis. While these amounts represent cash benefits per program, they are not instructive as to the total cash benefits that any client may be receiving. Further, they in no way take into account in-kind benefits.

Thus, we have a few gross tallies, percentages, and amounts for overall programs and categories. But the information currently available is woefully inadequate for a careful examination of disincentives that are in opposition to VR philosophy and services.

APPLICABILITY: Theoretically, findings from the study would be of significant social importance. A critical problem facing our legislators today is the establishment of effective governmental assistance programs. A great deal of pressure exists to establish a financial aid system which is helpful and yet equitable. If the findings from this study prove to be of significance, they should guide those who need more than intuition to construct this legislation.

Present policies of financial aid serve as environmental contingencies which serve to influence the actions of those who receive benefits. If the present set of contingencies which exist support behavior which is detrimental in the long run to either the individual or the assisting agencies in question, it is important to change them.

172 Development of a Valid Multiple-Factor Instrument to Assess Severity of Handicap

Principal Investigator:	**Richard Hartnett**	
Status:	**Continuing**	
Dates:	**October 1976-April 1978**	
Cost:	**Annual $60,016** **RT Annual $47,961**	**Projected Total $225,000** **RT % of Annual Total 80%**
Annual Report Reference:	**#12, Page 189, R-35**	

OBJECTIVES: The overall objective of this project is to develop, standardize, and validate a practical, cost-effective instrument to measure handicap severity. Such an instrument should ideally yield a profile for an individual that would measure components of handicap severity as follows: (1) degree of handicap in mobility; (2) degree of handicap in self-care; (3) degree of handicap in motivation and psychological independence; (4) degree to which individual perceives problems to exist in personal, social, family, and vocational adjustment; (5) impact of demographic variables on employability; and (6) related factors.

METHODOLOGY: Establishment of a methodology for this study will include the following: establishment of a panel of technical consultants, completion of literature search, evaluation of instruments or items for inclusion in a pilot battery, content analysis of resultant items, analysis of pilot inventory by reading specialists, preliminary field test of pilot battery with no less than 30 severely disabled clients, revisions of the inventory, reliability checks, concurrent validity tests, alternative weighting procedures, and norm development.

FINDINGS TO DATE: The research methodology has been reviewed by RSA. Recruitment of researchers, project coordinator, and technical staff has been completed. A Preliminary Diagnostic Instrument has been developed for field testing during April and May of 1978. Further development and refinement will take place during 1978-79.

APPLICABILITY: Once the multiple-factor instrument has been developed with an accompanying manual to facilitate its use, two forms of the manual will be developed for direct application to rehabilitation. Form A of the manual will be for client-serving personnel, such as counselors and vocational evaluators to aid in documenting eligibility, to sensitize client-serving personnel to differential needs of individual clients, and to assist in the development of the Individualized Written Rehabilitation Program for each client. Form B of the manual will be oriented toward program evaluators to use as a supplement to number of closures, to help specify agency policy and priorities in terms of intake practice, potentially, and to assess employability gain vs. employment.

173 Factors Influencing Work Adjustment of Disabled Workers

Principal Investigator:	**M. S. Tseng, Ed.D.**	
Status:	**New**	
Dates:	**May 1977-December 1981**	
Cost:	**Annual $25,982** **RT Annual $23,900**	**Projected Total $71,700** **RT % of Annual Total 90%**
Annual Report Reference:	**# 12, Page 200, R-36**	

OBJECTIVES:

1. To determine the nature of vocational rehabilitation clients' occupational entry into the competitive labor force after vocational rehabilitation closure, by generating a relative profile for the vocational rehabilitation client population within the total labor force which shows characteristic patterns of their entry jobs in terms of fields, skill levels, and wage levels.
2. To identify the work adjustment or adaptation problems uniquely encountered by disabled workers after placement.
3. To examine disabled workers' work adjustment in terms of satisfaction/dissatisfaction and satisfactoriness/unsatisfactoriness relative to their occupational functioning.
4. To determine the extent to which disabled workers' work motivation might be related to their work satisfaction and performance.

5. To identify variables which might serve to moderate disabled workers' work motivation-satisfaction relationship.
6. To investigate if certain job content and context elements might tend to function as satisfiers or dissatisfiers to disabled workers.
7. To identify factors which might contribute to disabled workers' successful (or satisfactory) work performance.
8. To identify third-variables which might contribute to more satisfactory explanation of disabled workers' work satisfaction-performance relationship.
9. To determine the extent to which disabled workers' work adjustment after rehabilitation closure might be attributable to the absence, as opposed to the presence, of vocational training during the rehabilitation stage.

METHODOLOGY:

1. The project objectives are to be accomplished through three consecutive phases of investigation. Phase 1 involves intensive analyses of a state R-300 data set and the corresponding labor statistics. Phase 2 is a survey stage within which a sample of disabled workers (former VR clients) and their respective employers are contacted. Phase 3 is to be an experimental study within a sheltered workshop.
2. A sample of approximately 4,600 VR clients who were successfully closed (status 26) and placed in competitive employment (work statuses at closure 1, 3, and 4) during FY 1975-76 in West Virginia is involved in Phase 1. Phase 2 requires a sample of approximately 200 clients who have been successfully rehabilitated (closure status 26), with one half of them having received vocational training (status 18) and the other half not, and their respective employers. A sample of approximately 20 sheltered workers (work status at closure 2) who have been successfully closed by VR (status 26) is to be involved in Phase 3.
3. Phase 1 addresses itself to 5 VR outcome variables (weekly earnings at closure, field of occupation at closure, etc.—the primary variables) and some 34 VR intake and process variables (age, sex, major disability, months from acceptance to closure, months in training, etc.—the secondary variables). Phase 2 taps 24 primary variables (including such employment variables as occupational title, weekly earning, satisfiers and dissatisfiers of job elements, work satisfaction, and work proficiency and such personal attributes as locus of control, self-esteem, self-acceptance, perception of success, work motivation, and work personality) and 9 secondary variables (sex, age, major disability, highest grade completed, etc.). Primarily two independent variables, self evaluation of work proficiency and pressure for production, and two dependent variables, work satisfaction and work performance, are to be investigated in Phase 3.
4. Univariate, bivariate, and multivariate descriptive and inferential statistics are used for data analyses.

FINDINGS TO DATE: The first phase of the project carried out to date reveals the following characteristics for a state R-300 data set for FY 75-76:

1. Of the clients closed in Status 26, approximately 71% were placed in competitive employment (work statuses at closure 1, 3, and 4).
2. As compared to those who were successfully closed but not placed in competitive employment (work statuses at closure 2, 5, and 6), clients who were successfully closed and placed in competitive employment (work statuses at closure, 1, 3, and 4) were found to have significantly different means on 6 ordinal intake variables and 2 ordinal process variables. They were on the average
    a. younger, with a mean age 33.8 as opposed to 41.5 ($p < .001$).
    b. having more dependents, with a mean number of dependents 1.2 as opposed to 0.6 ($p < .001$).
    c. from smaller families, with a mean number in family 3.3 as opposed to 3.5 ($p < .05$).
    d. more educated, with a mean grade level 9.9 as opposed to 8.6 ($p < .001$).
    e. earning more at referral, with a mean weekly earning $35.10 as opposed to $5.60 ($p < .001$).
    f. representing higher monthly family income at referral, with a mean 3.0 which is equivalent to $275 as opposed to 2.8 which is equivalent to $240 ($p < .01$).
    g. participants of longer period of training, with a mean months in training 3.3 as opposed to 1.0 ($p < .001$).
    h. recipients of more services, with a mean total number of services 2.4 as opposed to 2.3 ($p < .001$).

3. The frequency distribution of the competitive closures (work statuses at closure 1, 3, and 4) based on the 9 one-digit occupational categories was, in rank order, as follows: (a) code 3 service occupations (35.5%); (b) code 2 clerical and sales occupations (18.4%); (c) code 9 miscellaneous occupations (10.6%); (d) code 0-1 professional, technical, and managerial occupations (10.5%); (e) code 8 structural work occupations (9.5%); (f) code 6 machine trades occupations (4.5%); (g) code 7 bench work occupations (4.2%); (h) code 5 processing occupations (3.9%); (i) code 4 farming, fishery, forestry and related occupations (2.9%).
4. The distribution of those who entered the service occupations (one-digit code 3) based on the corresponding two-digit occupational codes was, in rank order, as follows: (a) code 31 food and beverage preparation and service (30%); (b) code 38 building and related service (18.0%); (c) code 35 miscellaneous personal service (17.8%); (d) code 30 domestic service (15.4%); (e) code 36 apparel and furnishings service (6.4%); (f) code 33 barbering, cosmetology, and related service (4.8%); (g) code 37 protective service (4.2%); (h) code 32 lodging and related service (2.9%); (i) code 34 amusement and recreation service (0.5%).
5. The occupational distribution of those placed in the clerical and sales occupations (one-digit code 2) based on the corresponding two-digit codes was, in rank order, as follows: (a) code 20 stenography, typing, filing, and related occupations (25.5%); (b) code 29 merchandising, except salesperson (23.0%); (c) code 21 computing and account-recording (17.8%); (d) code 26-28 salespersons, commodities (16.4%); (e) code 23 information and message distributon (7.1%); (f) code 22 material and production recording (6.2%); (g) code 24 miscellaneous clerical (2.7%); (h) code 25 salespersons, service (1.3%).
6. The occupational distribution of those placed in the miscellaneous occupations (one-digit code 9) was as follows: (a) code 91 transportation, not elsewhere classified (28.6%); (b) code 90 motor freight (24.0%); (c) code 93 extraction of minerals (18.4%); (d) code 92 packing and materials handling (17.0%); (e) code 95 production and distribution of facilities (6.2%); (f) code 97 graphic art work (1.7%); (g) code 94 logging (1.5%); (h) code 99 vending stand operation (1.5%); (i) code 98 other (0.7%); (j) code 96 amusement, recreation, and motion picture not elsewhere classified (0.4%).
7. The occupational distribution of those in the professional technical, and managerial occupations (one-digit code 0-1) was as follows: (a) code 09 education (20.5%); (b) code 07 medicine and health (18.2%); (c) code 18 managers and officials, not elsewhere classified (16.7%); (d) code 19 miscellaneous professional, technical, and managerial (12.6%); (e) code 16 administrative specialization; (f) code 00-01 architecture and engineering (6.3%); (g) code 15 entertainment and recreation (4.6%); (h) code 04 life sciences (4.0%); (i) code 12 religion and theology (2.9%); (j) code 02 mathematics and physical sciences (2.1%); (k) code 14 art (2.1%); (l) code 10 museum, library, and archival sciences (1.3%); (m) code 13 writing (1.0%); (n) code 11 law and jurisprudence (0.4%).

APPLICABILITY: This project produces much needed data on the circumstances of those former VR clients in the world of work. It is hoped that the data can be utilized in such areas as (1) sensitizing the rehabilitation personnel to the relative VR contribution to the nation's labor force, (2) post-closure follow through services, especially in reference to the competitive employment, (3) job development and job placement, (4) program evaluation using client post-closure job functioning as a criterion, and (5) other applications relative to the rehabilitation services involving jobs.

EDUCATION: A HERITAGE AND FUTURE FOR OREGON

University of Oregon (RT-16)
Mental Retardation Rehabilitation Research and Training Center

CORE AREAS

Program Related Assessment

The development of client assessment strategies and specific instruments that measure the behaviors of mentally retarded adults that are critical determinants of their potential for community adjustment.

Professional Growth and Development

Activities aimed at improving understanding of the major roles and functional demands of supervisory and management personnel in rehabilitation agencies; e.g., staff development specialists, rehabilitation educators, and first-line supervisors of rehabilitation counselors.

UNIVERSITY OF OREGON

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

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Legal Rights and Service Delivery

PROPOSED

Validity of the **Social and Prevocational Information Battery** for Predicting Vocational Adjustment of Mentally Retarded Adults

University of Oregon

Utilization of the **Social and Prevocational Information Battery**

A Sociological Look at the Retarded Persons' Perception of the World of Work

A Study of the Relationship Between Parental Overprotectiveness and the Achievement of Selected Life Skills Among Mildly Retarded Adolescents

Identification of Leadership Characteristics of "Successful" Supervisors in Vocational Rehabilitation

174 An Analysis of Public Assistance/Social Services for the Mentally Retarded

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1976-February 1977**	
Cost:	**Annual $11,500** **RT Annual $11,500**	**Projected Total $11,500** **RT % of Annual Total 100%**
Annual Report Reference:		

OBJECTIVES: The purpose of this study was to investigate how and to what extent advocate groups for the mentally retarded participated in the initial (1973) state Title XX planning process. Issues examined included: nature and distribution of Title XX material; nature of professional advocate group involvement; nature of relationships between involvement, influence and impact of professional advocate groups; and factors other than professional advocacy that affected Title XX planning process.

METHODOLOGY: A three part questionnaire was sent to the Executive Directors of the 50 state and the Washington, D.C. Associations for Retarded Citizens, and to the 50 staff directors of state and the Washington, D.C. Developmental Disabilities Councils. The questionnaire was designed to produce information about: demographic characteristics of the population surveyed, the nature and distribution of Title XX information received, and the nature of the involvement of the professional advocates.

In addition, technical notes analyzing major features of preliminary and final title XX plans were reviewed to document inclusion of mentally retarded individuals as target groups. Also, expenditure reports from all states and Washington, D.C. were reviewed to determine the percentage of each state's expenditures on services to mentally retarded individuals.

FINDINGS TO DATE: The following is a synopsis of the significant findings of this study:

1. A total of $1.6 billion was spent for social services under former Titles IV and VI of the Social Security Act for fiscal year 1973. Of this total, 12%, or $188 million, was spent specifically on services for the mentally retarded. The percentage range spent by each state on social services for the mentally retarded was 0-64% of the total state expenditure of social service funds;
2. The population studied was comprised of two professional advocacy groups for the mentally retarded, i.e., 51 staff directors of Developmental Disabilities Councils (DDC) and 51 executive directors of the state Associations for Retarded Citizens (ARC). In total, 87 of the 102 **Ss** (85%) returned the questionnaire, and all but two were used in the data analysis. Forty-nine **Ss** or 96%, and 38 **Ss** or 75% of the DDC and ARC staffs responded, respectively;
3. Professional advocates for the mentally retarded were provided Title XX information in sufficient time to become involved in the initial planning process. Seventy-two of the 85 **Ss** indicated they were informed about Title XX prior to the required data of the official publication of the preliminary state Title XX plans. As to who informed them, approximately 90% of the ARC **Ss** indicated their parent organization was responsible, whereas the DDC **Ss** did not indicate any such central source;
4. Both professional advocacy groups indicated that the Title XX materials they received met their purpose at a moderate to high level. In addition, both the ARC and DDC groups indicated the materials positively influenced their involvement in the Title XX planning process;
5. Both professional advocacy groups were more positive about the informal than the formal and required procedures of the Title XX planning process in terms of their potential impact upon the Title XX state plan. For example, at least 80% of both groups indicated they met with legislators. They also viewed informal meetings with Title XX staff as being the most potentially impacting type of involvement. By contrast, both groups viewed formal and required types of involvement (e.g., attendance at public hearings and formal comments on record) as having a lesser degree of impact upon the Title XX state plan;
6. Neither professional advocacy group was optimistic about change in the state Title XX plan as a result of its involvement in the planning process. Respectively, only 4 or 19% and 3 or 12% of the ARC

and DDC **Ss** indicated "much" change. In addition, 11 or 52% and 14 or 56% of the ARC and DDC **Ss** indicated "no" or "slight" change as a result of their involvement; and

7. A review of the 51 Title XX state plans (Technical Notes) indicated that the mentally retarded were included as a specific target group in 18 preliminary plans and that only 8 of these states designated the mentally retarded in their final plan. In total, only 12 states designated the mentally retarded as a specific target group in their final Title XX plan.

APPLICABILITY: The findings of this project should be of use to a wide variety of people providing services to the mentally retarded. This would include vocational rehabilitation counselors, public welfare caseworkers, and Developmental Disabilities Council administrators. Recognition of the importance of Title XX planning should lend impetus to the expansion of social services.

175 A Follow-Up Study of Rehabilitation Short-Term Training

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1976-August 1977**	
Cost:	**Annual $4,600** **RT Annual $4,600**	**Projected Total $4,600** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 160, R-37**	

OBJECTIVES: The purpose of this study was to investigate a strategy for follow-up evaluation of rehabilitation short-term training.

It examined the relative efficacy of two different approaches to conducting a follow-up evaluation of the impact of short-term training; a mail out procedure and a personal interview procedure, both involving response to open-ended items on a follow-up questionnaire. Further, the study examined whether a relationship existed between various trainee characteristics and/or immediate outcome evaluations, and the dependent variable of change scores on the open-ended follow-up questionnaire.

METHODOLOGY: Sixty-two of 70 agency trainees who participated in these one-week seminars at the Center and who completed the immediate outcome evaluations immediately after training were randomly divided into two groups of 31. Group A received the follow-up mail survey and Group B were personally interviewed. In Group A, 22 (71%) completed the mailed questionnaire, and in Group B, 29 (94%) completed the personal interview.

The questionnaire and interview consisted of a set of open-ended items directed toward Professional Practice change which consisted of stimulus words such as mental retardation, vocational assessment, deinstitutionalization, severely retarded, etc. These items were derived from program content of the seminars. Respondents were asked to describe, in an open-ended manner, any changes in their behavior with respect to these 16 stimulus words (phrases) that occurred at least partially as an outcome of their training experience.

Two doctoral candidates in the Departments of Counseling and Sociology served as the interviewers for Group B. Neither of them were acquainted with the former trainees nor had experience with the R-T Center short-term training programs. Both were carefully instructed and rehearsed to avoid answering the items in the questionnaire for the subject.

FINDINGS TO DATE: The results clearly demonstrated that the open-ended items of the Follow-Up Questionnaire do reflect changes in professional practice, regardless of the method of data gathering employed. In essence, this finding supports the usage of open-ended items in a mail questionnaire in that responses can provide useful self-report information.

The importance of this finding for training personnel should not be overlooked: The savings in time, money and personnel of a mail-out instrument are apparent. An additional, but no less important, savings related to the mail questionnaire format is that provided by the structure of the instrument itself. The space allotted for responses is limited. Thus, responses to such items are more likely to be brief and to the point. It seems clear that open-ended items on a mailed follow-up questionnaire are both appropriate and feasible.

However, if open-ended items are to be employed in the follow-up evaluation of short-term training, it seems essential, in terms of the results of this study, that such items be streamlined to correspond directly to the key descriptors used to identify the major program emphases of the training seminar.

APPLICABILITY: The results of this study have direct implications for the types of short-term training programs provided to different groups (populations) of rehabilitation practitioners. The possible interaction between characteristics of trainees, the types of training received, and the kinds of changes they report both at the conclusion of training and following a period of time, provide useful information to both training personnel and to state agency personnel. In addition, others involved in both the technology and provision of short-term rehabilitation training, such as RCEP personnel, may be able to generalize from the results of this study to the development and/or improvement of their own instruments for follow-up evaluations.

It is anticipated that the results of this study would provide information that could be utilized for (1) decision-making geared toward program improvement, and (2) accountability of short-term training for rehabilitation practitioners.

176 Research Needs in Vocational Rehabilitation

Principal Investigator:	**Gilbert Foss, Ph.D.**	
Status:	**Completed**	
Dates:	**Dates: March 1976-February 1978**	
Cost:	**Annual $17,508**	**Projected Total $35,000**
	RT Annual $17,508	**RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 244, R-41**	

OBJECTIVES: In order to most effectively determine priority research needs for improving rehabilitation service delivery to mentally retarded consumers, the following objectives have been delineated:

1. To identify those problems of retarded people which are at present the least adequately met, as perceived by
   a. retarded persons in community settings;
   b. service delivery professionals, i.e., vocational rehabilitation counselors and workshop facility personnel.
2. To determine the degree of correspondence between the perceptions of retarded persons and those of service delivery professionals regarding the identified problems.
3. To identify the major research needs emanating from the problems identified by retarded persons and service delivery professionals.

METHODOLOGY: Three sequential steps are being followed in this needs assessment project. First, a literature review was conducted to determine critical domains of living for use in problem identification. The domains chosen for study were: (1) employment; (2) social relationships; (3) and community living. Following the delineation of domains, consultant groups of service delivery professionals and of mildly and moderately retarded consumers were utilized for the purpose of identifying the major problems of retarded persons. The system used for the identification of problems by the consultant groups was the group problem analysis procedure known as the "Nominal Group Technique."

The second step of this study is concerned with expanding and prioritizing the problem identification data obtained from the consultant groups. Separate instruments were developed for each of the two major subject groups, an Interview Schedule for consumers and a questionnaire for service delivery professionals. Step three involves the translation of the prioritized problems into a list of critical research needs. A task force of professional researchers in the field of rehabilitation and mental retardation will be utilized to generate critical research needs for potential study by this center and other interested agencies or individuals.

FINDINGS TO DATE: **Objective One: Problem Identification.** The following results pertain to phase one of the study in which consultant groups of mentally retarded rehabilitation consumers (N=58) and consultant groups of rehabilitation service providers (N=60) identified problems in the three domains of Employment, Community Living, and Social Relationships. In the employment domain, the consumer group identified six major problems: working fast enough, getting to work on time, finding a job, interviewing for a job, getting along with the boss, remembering appointments. The Service Providers identified seven problems in this area: employer discrimination in hiring, lack of social skills necessary for tenure after job placement, inappropriate parental expectations regarding job placement, limited availability ofjobs or stereotyped jobs, difficulty handling on-the-job pressures such as working independently or meeting industrial standards, inadequate job search or interviewing skills, inadequate skills to utilize available transportation for finding or holding a job. In the Community Living domain, consumers noted six problems: managing money, getting around to places, making change with money, getting along with a bad neighbor, getting help from the community, such as with jobs, food, and health care, being treated differently from others. The Service Providers cited seven problems in this area: lack of adequate skills for budgeting or handling money, discrimination in opportunities to participate in community activities, inadequate skills for finding or using recreational resources, inadequate skills to utilize available transportation for getting around in the community, inadequate interpersonal communication skills for interacting appropriately with members in the community, inadequate skills for personal hygiene or preventive health care, inadequate home management skills such as cooking, cleaning, and home maintenance. In the Social Relationships domain, the consumer group described six problems: getting along together as a family, getting along with the police, talking in a group of people, finding or keeping friends, getting parents to allow them more freedom in making decisions, getting along with a boyfriend/girlfriend or husband/wife. The service provider group also identified six problems in this area: obstacles in forming normal social, romantic, or sexual relationships outside the home as a result of maladaptive family interactions, inadequate skills or opportunities for appropriate sexual expression, obstacles of discrimination by the general public, inadequate interpersonal communication skills for forming or maintaining personal relationships, inadequate skills to utilize available transportation for forming or maintaining personal relationships.

Objective Two: Problem Prioritization. The second phase of the study was concerned with the prioritization of the problems identified in Objective One, and examining the relationship between the prioritized rankings of the service consumers and the service providers. The consumer identified problems were ranked both by consumers and service providers; by 101 retarded persons via the Forced Choice Inventory (FCI) and by 277 rehabilitation service providers via Part B of the Service Provider Questionnaire (SPQ). The service provider identified problems were prioritized only by the 277 service provider respondents on Part A of the SPQ.

A Spearman rank order correlation analysis indicated that little relationship existed between the rankings of the two groups in the Employment domain (rs = -.03) or in the Community Living domain (rs=.33). A very strong correlation (rs=.83) resulted between the two sets of rankings on the Social Relationship items. However, **all** 18 problem statements identified by the mentally retarded consumers, and **all** 20 problem statements identified by the service providers are important. The Nominal Group Technique used in the problem identification phase of the study is designed to "weed out" insignificant items.

Objective Three: Priority Research Problems and Obstacles to Remediation. A major purpose of this study for the Oregon RT Center was to establish priority problem areas for potential new research starts. In order to gain information regarding "feasibility" and "need for research," the 20 service provider-generated items were also ranked by 28 researchers in the area of mental retardation in the United States.

The researcher respondents were asked to rank order the set of problem statements in each of the three domains of Employment, Community Living, and Social Relationships according to rank 1 = problem most in need for research, and rank 6 (or 7) = problem least in need of research.

Based upon an examination of the service provider and research rankings, and the obstacles to remediation identified by the service provider respondents, six problem statements (two in each domain) were identified as priority research problems. In the following section, each problem statement so identified is listed together with the major obstacles to remediation identified for that statement by the service providers.

Employment Domain Problem Statement #1. Retarded persons have difficulty handling on-the-job pressures such as working independently or meeting industrial standards.

Obstacles to Remediation

1. Employers are unable or unwilling to help employees who have such problems.
2. There is a shortage of realistic prevocational training programs.
3. There is limited staff time available to help clients become work adjusted after placement.
4. Because retarded persons have a short attention span, they will always need more supervision.
5. Facilities need a greater variety of work samples in order to better stimulate industrial settings.

Employment Domain Problem Statement #2. Retarded persons lack the social skills necessary for tenure after job placement.

Obstacle to Remediation

1. There is a lack of training programs directed toward social skills.

Community Living Domain Problem Statement #1. Retarded persons lack adequate skills for budgeting or handling money.

Obstacles to Remediation

1. Retarded persons have little or no experience with money because whatever income he/she now gets usually is controlled by parents or house parents.
2. Little training is provided in these skills by schools, group homes, facilities, or vocational rehabilitation.
3. These skills seem particularly difficult for retarded persons to grasp.
4. There is a lack of materials for use in teaching these skills.

Community Living Domain Problem Statement #2. Retarded persons lack adequate interpersonal communication skills for interacting appropriately with members of the community.

Obstacles to Remediation

1. There is a lack of training programs designed to teach retarded persons interpersonal communication skills.
2. Retarded persons are provided few opportunities to learn to use interpersonal communication skills with anyone but other clients or staff members.
3. Members of the community are not supportive of the existence of retarded persons within the community.
4. Community members interact with retarded persons as though they are children.

Social Relationship Domain Problem Statement #1. Retarded persons are hindered in forming normal social, romantic, or sexual relationships outside the home as a result of maladaptive family interactions.

Obstacles to Remediation

1. The protective attitudes of the family and significant others precludes any opportunity for normal social interaction.
2. Parents and professionals still assume retarded persons will never form sexual relationships; they have difficulty accepting the physical and emotional needs of retarded persons.

Social Relationship Domain Problem Statement #2. Retarded persons lack adequate skills and opportunities for appropriate sexual expression.

Obstacles to Remediation

1. There is a lack of adequate training and counseling on sexuality for retarded persons.
2. Family members and professionals discourage sex education, and the forming of sexual relationships by retarded persons.
3. Retarded persons are not given privacy.
4. Parents and professionals assume retarded persons will never form sexual relationships.

APPLICABILITY: The potential users of the materials generated through this project are all professional rehabilitation personnel interested in the major obstacles to rehabilitating mentally retarded persons. The main audience, however, will be rehabilitation researchers in mental retardation, particularly staff from the Oregon R-T Center. The range of potential users will increase in the future as the rehabilitation system responds to the 1973 RSA Amendments concerned with the severely disabled.

University of Oregon

177 Physical Education, Recreation and Physical Therapy for the Mentally Retarded: Guidelines and Procedures

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1977-August 1977**	
Cost:	**Annual $4,536** **RT Annual $4,536**	**Projected Total $4,536** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 238, R-46**	

OBJECTIVES: A major purpose of this study was to develop an educational compliance package in the area of physical education. Specifically, the objectives were:

1. To develop a set of procedures which would enable personnel in physical education, recreation, and physical therapy to conduct their programs in compliance with P.L. 94-142.
2. To develop technical assistance procedures for administrators for disseminating sets of procedures and for collecting necessary data relative to the procedures.
3. To develop a checklist by which the Oregon State Education Agency would be able to determine areas of compliance or non-compliance with P.L. 94-142 for physical education programs.
4. To field test the set of procedures in five school districts.

METHODOLOGY: Components of the procedural package were selected on the basis of their relevance to the identification, location, evaluation, and programming of handicapped children as required by P.L. 94-142. All of these activities can be viewed as a process which results in the development of an individualized education plan for a handicapped child. Field testing of the procedural package occurred from March to June, 1977. Five districts were selected from around the State of Oregon on the basis of criteria designed to provide sites representative of the various conditions present in the over 300 school districts within Oregon. Arrangements were made with each individual district for the provision of approximately 17 days of consultant time. There were five consultants, each of whom took primary responsibility for one district. Initially, time was allotted for orientation to the provisions of P.L. 94-142 and later technical assistance was provided for implementing the procedural package. Consultants monitored pertinent procedural forms and records maintained by field-test personnel. This included screening instruments, referral forms, assessment information, and individualized education programs. In addition, consultants were asked at times to provide resource materials, present at in-service training sessions, conduct asessments, and model the performance of procedural steps, such as conducting a meeting for the development of an IEP. Districts were expected to complete the entire process from screening to placement for only about three children for each participating school. The package was revised following field testing.

FINDINGS TO DATE: Development, field testing, and revision of the procedural package have been completed. Procedures and support materials for physical education have been integrated into a package which has been printed by the Oregon Department of Education. Materials developed specifically for physical education include:

-- Guidelines for Developing Physical Education Services
-- Physical Education Screening
-- Physical Education Medical Referral Form
-- Physical Education Assessment Considerations
-- Taxonomy of the Psychomotor Domain
-- Relationship Between Assessment and Programming in Physical Education (chart)

The most evident implication to be drawn from these results is that physical education teachers and classroom teachers must receive intensive in-service training if they are to become knowledgeable about P.L. 94-142 and develop more positive beliefs about its impact. If compliance with the law is to be effective, assurance should be made that students who are mainstreamed receive a quality of services at least as good as what is provided in segregated settings. Also, teachers should be acquainted with ways of working with handicapped students which do not infringe upon the teaching time for nonhandicapped children. Finally, although teachers may be positive about some general benefits of integration for the severely handicapped, they are negative with regard to specifics such as the quality of services which can be provided, social acceptance of handicapped students by their peers, and available teaching time for individualizing instruction.

APPLICABILITY: The procedural package developed has been distributed by the State Education Agency to Local Education Agencies (LEAs) and Intermediate Education Districts (IEDs) throughout the State of Oregon and to agencies in other states upon request. The procedural package includes program development information and a checklist for ascertaining compliance with state and federal laws and regulations. Agencies lacking in services or otherwise not in compliance with the laws should be better able to make policy and programmatic changes in order to obtain state and federal funding for their programs, as well as provide better services for handicapped students.

178 Predicting Rate of Acquisition and Production of Complex Industrial Tasks by Institutionalized Moderately and Severely Retarded Adults

Principal Investigators: Larry K. Irvin, Ph.D.
G. Thomas Bellamy, Ph.D.
Status: Continuing
Dates: July 1974-February 1979
Cost: Annual $36,497 Projected Total $150,000
RT Annual $32,565 RT % of Annual Total 89%
Annual Report Reference: #12, Page 64, R-31

OBJECTIVES:

To evaluate further the psychometric characteristics and utility of two assessment instruments, the Trainee Performance Sample and the Becker Adjective Checklist, for predicting training time and facilitating training selection and program evaluation.

METHODOLOGY:

The subject pool consisted of 300 severely retarded residents of Fairview Hospital and Training Center, located in Salem, Oregon. Work on further development of the **Trainee Performance Sample** (TPS) consisted of initial efforts to revise the TPS to reflect a broader set of skill areas than were originally represented.

Work on the **Becker Adjective Checklist** consisted of: (1) completion of data collection activities that were designed to acquire a second series of ratings by Fairview ward staff;, and (2) factor analysis and test-retest reliability analyses to investigate (a) utility of a scoring system based on factor structure, and (b) stability over time of measures derived from application of that scoring system when the **Becker** instrument is used with institutionalized severely and profoundly retarded individuals.

FINDINGS TO DATE: Development of new items for inclusion in the **Trainee Performance Sample** (TPS), reflecting a broader set of skill areas, was begun.

The outcomes of the research involving the **Becker Adjective Checklist** resulted from several kinds of data analyses. Factor analysis yielded five significant factors, and these were labeled Withdrawn, Disruptive, Incompetent, Tense, and Non-Compliant. Adjective pairs with either positive or negative loadings greater than .45 on each factor were identified. Also identified were the items which loaded above .45 on similarly labeled factors obtained by Patterson and Fagot (1967) and Becker (1960). Factors which emerged from these analyses were strikingly similar to those obtained previously by Patterson and Fagot and Becker with quite different populations of raters and ratees.

A scoring system similar to that used by Patterson, Cobb, and Ray (1973) was developed to derive easily computed scores based on the five factors. The correlations between total scores on each factor for the first and second test range from .536 to .755 and are all significant beyond the .001 level. The checklist and scoring system thus result of scores which are relatively stable across time. The results of this factor analysis and scoring evaluation suggest that the semantic differential developed by Becker (1960) may be a useful instrument for evaluation of programs for severely retarded persons.

Dissemination efforts involved the development and publication of a second review of project and related activities completed within the Specialized Training Program (Bellamy, 1977).

In addition, project results from the first three project years have been integrated into three replications of the Specialized Training Program in Reno, Nevada; Seattle, Washington; and Spokane, Washington.

Finally, project results are continuously integrated into RT Center and Specialized Training Program short- and long-term training programs. For example, at least one training session based on project results was included in every RT Center campus workshop this past year.

APPLICABILITY: The findings of this project will yield three major implications for practice changes. First, they will provide vocational trainers with a behavioral assessment of performance on specific task criteria rather than a global assessment of work abilities. Second, they will produce a validated set of predictor variables which could increase the accuracy of significant managerial decisions. And third, they will derive from a population not previously considered as potential candidates for sheltered workshops.

179 Training Evaluation Kit

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Continuing**	
Dates:	**March 1975-February 1979**	
Cost:	**Annual $19,975** **RT Annual $19,975**	**Projected Total $150,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 175, R-35**	

OBJECTIVES: The purpose of this study was to further investigate the psychometric properties of the TEK Follow-Up Evaluation instrument. In addition, the objective was to expand the utility of the instrument by developing a form for a specific target group, i.e., rehabilitation facility personnel. The major research questions addressed in this study were:

1. Does the follow-up instrument designed for rehabilitation facility personnel possess adequate reliability properties? and
2. Is there a significant difference in training impact as measured by the follow-up due to time interval between the conclusion of training and follow-up?

METHODOLOGY: The setting in which this study took place was the Region IV Rehabilitation Facility Training Program at Auburn University. The population for the study consisted of those 105 participants who attended the six three-week seminars held at the University between June 1975 and July 1976.

The **Follow-Up Questionnaire** was an instrument that has evolved through the research conducted by Browning (1976), Perry (1975), Foss (1975), and Smith (1977). The instrument format was modified from that of a rehabilitation field counselor orientation to a rehabilitation facility personnel orientation.

In each question on the instrument, with the exception of the Professional Development and the Professional Practice summaries, the respondent was asked to do two things: (1) compare his level of activity during the time period after the seminar with a base line using the same time period before the training; and (2) determine whether the seminar was a contributing factor in each particular activity in each question. In effect, the respondent was asked to establish his own baseline of behavior and to determine what connection, if any, there was between a change in behavior and the seminar.

Table 1 provides a breakdown of the subjects who answered the follow-up questionnaire in terms of both test and retest.

Table 1

Responses to Follow-Up Questionnaire

(N=99)

	Test		Retest	
Responses	N	%	N	%
Questionnaires Sent	99	100	86	87
Completed Questionnaires Returned	86	87	76	77
Unacceptable Questionnaires Returned	1	1	3	4
Refused to Participate	1	1	0	0

FINDINGS TO DATE: Coefficient Alpha was .89 for the **Follow-Up Questionnaire.** Reliability criteria for instruments with 25-30 items are usually about .80. Thus the **Follow-Up Questionnaire**, as used in this study, can be considered to be highly internally consistent. Because the instrument proved to be internally consistent, item scores can be summed in order to arrive at a total score to address Research Question Two.

The stability of the **Follow-Up Questionnaire** was analyzed by correlating total scores by a test -- two-week interval -- retest comparison. A Pearson Product Moment Correlation on the total scores of both tests was 0.924. Respondent's relative position did not change substantially over time. This demonstrated that the follow-up instrument has substantial stability over time, and measurement error is minimal.

The primary purpose of developing the **Follow-Up Questionnaire** was to provide trainers of rehabilitation facility personnel with an instrument which would assess the impact of short-term training programs at certain time intervals after the conclusion of training. The analysis of the total scores of the respondents in three time segments (short, 3 to 5 months; medium, 7 to 11 months; and long, 14 to 15 months) indicated that there was little effect of time interval between training and follow-up on the Follow-Up Questionnaire Total Score. This provided an indication of the stability over time of the impact of the short-term training.

APPLICABILITY: For the past six years, the training staff of the University of Oregon Rehabilitation Research and Training Center have been involved in the evaluation of short-term training. The result of this effort is the development of **Training Evaluation Kit** (TEK). TEK is designed to obtain evaluative information on both training **process** and **impact**. The process areas of concern are training objectives, methods, and immediate outcome. This evaluative information is used for decision-making directed toward program improvement. The areas delineated for training impact are professional development, professional practice, and information dissemination and utilization. This evaluative information is used to determine accountable change due to training. This study was intended to further examine the psychometric properties of the Follow-Up instrument which is designed to measure the long-range effects of short-term training.

180 Supervision in Vocational Rehabilitation

Principal Investigator:	**R. William English, Ph.D.**	
Status:	**Continuing**	
Dates:	**May 1976-February 1980**	
Cost:	**Annual $93,785** **RT Annual $93,785**	**Projected Total $300,000** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 191, R-40**	

OBJECTIVES:

1. To describe the supervisory process in vocational rehabilitation.
2. To implement, through an original research utilization project, the findings of the proceeding descriptive study of first-line supervision in vocational rehabilitation agencies.
3. To effect widespread dissemination and utilization of the implementation project in public vocational rehabilitation agencies in a multi-regional area.

METHODOLOGY:

1. **Literature review.** Books, periodicals, and manuscripts are being reviewed from a variety of sources to gather the best possible picture of a number of supervision issues, e.g., selection, training, theory, practice, and outcomes.
2. **Individual interviews.** On-site interviews are being conducted with vocational rehabilitation counselors, supervisors, managers, and administrators to supplement data collected via questionnaires and small group need assessment procedures. An interview schedule was developed as a stimulus tool for use in interviewing.
3. **Nominal group process exercises.** This on-site procedure consists of the identification of a need area, which is presented to a small group — usually 10-15 vocational rehabilitation personnel. A useful item in this research has been: "List 4 suggestions which, if implemented, would increase the effectiveness of first-line supervisors." The group is then directed by experienced facilitators through four steps: problem identification, listing of problems, clarification and revision of problems, and problem resolution.
4. **Questionnaires.** Survey questionnaire booklets consisting of questions concerned with supervisory selection practices, training, evaluation, and how supervisors assist counselors to rehabilitate retarded clients have been mailed to a stratified random sample of counselors, supervisors, managers, and administrators employed in more than 40 general vocational rehabilitation agencies.

FINDINGS TO DATE: Activity to date focused on seven major task areas: (1) staff recruitment; (2) planning; (3) literature/materials search; (4) instrument construction; (5) data collection; (6) data analysis; and (7) reporting findings.

1. **Staff recruitment.** This step was completed with the hiring of a Research Associate with extensive supervisory/administrative experience in state service delivery to developmentally disabled persons, and in the recruitment of an experienced Research Assistant/Programmer.
2. **Planning.** Major planning steps completed were: (1) receiving project endorsement from the Council of State Administrators of Vocational Rehabilitation (CSAVR); (2) formation of a consumer task force of rehabilitation practitioners as project advisors; (3) planning research design and methodology; and (4) receiving project approval of University of Oregon's Committee for Protection of Human Subjects.
3. **Literature/Materials search.** All relevant professional literature was reviewed for implications for the current study. Additionally, existing materials being used by state vocational rehabilitation agencies were obtained and reviewed in four areas of supervision: (1) selection, (2) training, (3) practice, and (4) evaluation.
4. **Instrument construction.** Two kinds of instruments were constructed: an interview schedule and questionnaires. Both types were developed by project staff but both were substantially influenced by input from project advisors and project consultants. The interview schedule and the mailed questionnaires both dealt with the areas of supervisory selection, training, practice, evaluation, demographic background, and the supervision of counselor's work with mentally retarded persons.

A substantial amount of time and effort was devoted to the development and refinement of the objective research instruments. The discrete steps involved in this effort follow:

(1) **Drafting questionnaires** — the project staff generated a large comprehensive pool of items. These items were subsequently grouped into six content areas related to supervisory selection, supervisory training, supervisory practice, supervisory evaluation, demographic background, and supervision of counselors work with mentally retarded persons.

(2) **Preliminary technical and content review** — other R-T Center staff and an outside management consultant reviewed the six questionnaires measures and made suggestions for improving the instruments' technical quality and content relevance.

(3) **Revision of questionnaires** — questionnaires were revised to reflect the input of other R-T Center staff and the outside management consultant.

(4) **First field testing** — an initial group of state vocational rehabilitation counselors and first-line supervisors evaluated the questionnaires for content and item relevance and to determine the average time for completing questionnaire items.

(5) **Revision of questionnaires** — questionnaires were revised to reflect the input of the vocational rehabilitation agency counselors and supervisors who participated in the initial field testing.

(6) **Second field testing** — a second group of state vocational rehabilitation administrators, managers and trainers evaluated the questionnaires for content and item relevance and to determine the average time for completing questionnaire items. This Advisory Task Force consisted of persons from five western sites.

(7) **Secondary technical and content review** — four outside consultants, three employed by state vocational rehabilitation agencies, closely scrutinized the training and practice questionnaires and made suggestions for improving the instruments' technical quality and content relevance.

(8) **Final revision of questionnaires** — the project staff used the input of the Advisory Task Force group and the outside consultants to make final revisions. Their input allowed staff to quantify a number of open-ended questions and to substantially shorten the length of the various instruments. Subsequently, the instruments were collapsed into two survey research booklets of equal length, approximately 55 minutes. One booklet collected demographic information and researched the content areas of supervisory training and evaluation and the supervisor's work with counselors of retarded persons. The second survey booklet collected demographic information and investigated the content areas of supervisory selection and practices and the supervisor's work with counselors of retarded persons.

5. **Data collection.** the questionnaires were mailed to 2,284 vocational rehabilitation personnel in 43 state agencies. This included vocational rehabilitation counselors, supervisors, managers, and administrators. Questionnaires were returned by 1,645 or 72% of the sample population.

   (1) **Individual interviews.** On-site individual interviews with vocational rehabilitation counselors, supervisors, managers and supervisory clerical staff were conducted in various vocational rehabilitation offices in Oregon, Nevada, California, and New York.

   (2) **Small group needs assessment exercises** were conducted in the above-mentioned vocational rehabilitation offices. Small groups of 8-10 counselors and supervisors listed, clarified and prioritized specific suggestions which they believed would improve the effectiveness of first-line supervisors. Both the individual interview and the small group needs assessment material will be used to supplement the questionnaire data to provide a comprehensive picture of the current state-of-the-art of supervision in the vocational rehabilitation agency. Some of this information will bear on the planning and implementation of an original supervisory training demonstration with professional staff persons in the state vocational rehabilitation agencies.

6. **Data analysis.** Questionnaire data was analyzed through the use of the Statistical Packages for Social Sciences (SPSS) program, which yielded adjusted frequency percentages for each item and for each personnel group (Administrators, Supervisors, and Counselors). The adjusted percentage data was also subjected to tests of statistical significance using the Chi Square method, to examine differences between personnel groups as they might be influenced by the following intervening demographic variables: (1) state agency size; (2) age; (3) years in the VR agency; and (4) level of academic degree.

7. **Reporting findings.** A research monograph is near completion and will be disseminated to

vocational rehabilitation agencies and other consumers in the near future. Findings include the following highlights:

(1) Most rehabilitaion administrators and counselors are dissatisfied with current methods for selecting first-line rehabilitation supervisors.

(2) A majority of rehabilitation professionals believe the lack of an effective agency supervisory development program is a major obstacle to improvement of the selection process.

(3) Nearly all rehabilitation professionals (86-88%) indicate that first-line supervisors should have two to three years of work experience as a rehabilitation agency.

(4) Rehabilitation counselors, supervisors, and administrators generally feel that supervisors' job responsibilities greatly exceed their job authority.

(5) Most rehabilitation professionals feel that rehabiltation supervisors have two primary professional roles -- administration and case consultation -- and three secondary roles -- direct service, evaulation, and community liaison.

(6) Rehabilitation professionals, especially administrators and counselors, believe current supervisors presently do a poor job in many functional areas of counselor consultation.

(7) A majority of participants (62-72%) do not feel that the agency is currently providing adequate resources for the training of first-line supervisors.

(8) Most rehabilitation professionals (83-93%) believe that short-term training is likely to produce more effective first-line supervisors.

(9) A majority of participants believe it is important that persons **above** and **below** the level of first- line supervisors should receive similar supervisory training experiences.

(10) A majority of participants (50-67%) are dissatisfied with their agency's current supervisory evaluation procedures.

(11) The lack of validated **objective** and **subjective** evaluation criteria were identified as the two major obstacles to the improvement of the supervisory evaluation system.

(12) A majority of participants (54-61%) state that supervisors should receive special training to assist counselors who work with retarded persons.

(13) A substantial proportion of professionals believe that the expected successful closure rate for retarded persons should be lower than the rate for other disability groups.

APPLICABILITY: This project holds four implications for policy, program and practice changes in vocational rehabilitation. First, it will influence the professional knowledge and skills of first-line supervisors. Second, it will provide administrative leaders with a data base for considering change in the state agencies' present system of first-line supervision. Third, study materials will be of assistance to specialists responsible for the selection, training and evaluation of supervisors. Fourth, it will help rehabilitation counselors to be better consumers of supervisory practices.

181 A Sociological Look at the Impact of Normalization

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**Continuing**	
Dates:	**March 1976-August 1978**	
Cost:	**Annual $6,786** **RT Annual $ 2,894**	**Projected Total $25,000** **RT % of Annual Total 43%**
Annual Report Reference:	**#12, Page 91, R-42**	

OBJECTIVES: The primary objective of the study is to ascertain the impact of normalization on retarded persons placed in a group home. Specifically, the objectives are: 1) To investigate the patterns of daily interaction between consumers (retarded adults) and their significant others (service providers and the general public) employing the method of participant-observation; 2) to analyze the field note and interview data derived from participant-observation at three sociological levels, i.e., interpersonal, institutional, and social interaction; 3) to generate propositions and hypotheses relating to normalization within a sociological context.

METHODOLOGY: Since the purpose of the proposed research is to elucidate the meaning and impact of the normalization process for consumers, service providers, and the general public, participant-observation is a particularly appropriate methodology. The study is being carried out at two levels – descriptive and analytic. At the descriptive level, participant-observation provides techniques to systematically gather data on the process of normalization; at the analytic level, it provides techniques to develop a typology or theoretical model that will furnish an explanation of the factors underlying the observed process of normalization.

The research design was based on the idea that the most valuable information can be obtained from a relatively small group of persons who are significantly involved in the normalization process. Sampling procedures for research informants were adapted to this principle. Instead of discovering typical effects of normalization through extensive sampling, they will be discovered by intensive study of the interrelationship of three levels of analysis, i.e., interpersonal, institutional, and social interaction; 1) The interpersonal level – this is aiming directly at efforts to deal with interpreting, adopting, and incorporating normalization and its interpersonal effects; 2) the institutional level – focus is on the institutions involved in the normalization process, i.e., the group home and work setting, in their attempts to prepare the retarded adult for community living.

The researcher is investigating the contradictions and cross pressures which exist between these institutions and within each one; 3) patterns and forms of social interaction – the normative rules of giving, receiving, and experiencing normalization "in action" are being examined.

FINDINGS TO DATE: As an overt participant-observer, the researcher continues to present himself, in each social setting explored, as a sociologist interested in the assimilation of retarded persons into their community.

The following is a partial list of the social settings and people the researcher has dealt with in the course of investigation: 1) Syracuse, New York: **The "Heart" of the Normalization Movement** – The researcher has spent two months in Syracuse, New York, talking and working with key proponents of the normalization principle including its North American founder, Wolf Wolfensberger. In addition to informal conversations with Wolfensberger and mainline advocates of normalization at The Center on Human Policy, the researcher has visited group homes as well as an institution in the Syracuse area which are applying normalization. In addition, the researcher has attained more structured instruction on normalization by attending a four-day workshop given by Wolfensberger. Through contact with these key people, the researcher has developed a clear understanding of the ideological and programmatic intentions of normalization as well as many of the problems associated with it; 2) **A Group Home for Mildly Retarded Adults** – As an overt participant-observer, the researcher has spent many hours with group home operators and consumers of facility. Through contact with these people, the researcher has developed a trusting and cooperative relationship with them, maximizing their value as informants of the practice of normalization. The researcher has also spent time as a volunteer for the group home, acting as coordinator of its community awareness program, a skills tutor, and in many instances has simply been a "gracious ear" for persons operating and receiving services from the facility. Finally, the researcher has attended staffings on consumers, sat in on counseling sessions between service providers and consumers, conducted skills workshops on the use of household tools and pocket calculators, as well as just sitting around and talking informally with consumers and service providers; 3) **A Work Setting** – As an overt participant-observer, the researcher has spent considerable time in the work site of several of the group home consumers. During the course of the research, it became apparent that the work setting was an important social setting related to the normalization experience. The researcher observed service providers and work supervisors in their interaction with consumers in daily work activity. Other field experiences of the researcher include: (a) attending staffings on consumers, (b) participating in a weekly meeting where employees and staff were invited to voice feelings and gripes, and (c) informal discussions with personnel advisors, production managers, work supervisors and workers; (4) **In the "Public Eye"** – Over the course of the preliminary investigation, the researcher befriended four retarded adults and spent time with them in leisurely activities that took them into their community. Through this contact, the researcher became known as "a friend" by the consumers and a "citizen advocate" by the group home operators; 5) **Informal Interviews** – The informal interview has been an important tool in investigation to date. The researcher has interviewed the following people: (a) group home staff, including the executive director, group home coordinator, and maintenance personnel, (b) consumers living in the group home, and (c) production managers, personnel advisors, and work supervisors in the work setting. During the course of the study, the researcher will continue to interview key personnel and consumers as new theme, problems, and working hypotheses develop. People in the general public will also be informally interviewed as the study progresses.

APPLICABILITY: A Current movement in field of mental retardation is deinstitutionalization, one result of which has been the development of community alternatives such as group homes.

The evaluation of community alternatives to date has paid no attention to the details and nuances of the normalization process and their effects on consumers (retarded persons) and their significance to others. In order to demonstrate the success of group home efforts, the direct experience of retarded persons and their adaptation to this translation and change in life-style there must be investigated.

Such knowledge has the possibility of enhancing our learning about important ways to improve the environment of retarded persons so that they may participate more fully in society, contribute as citizens, and, to the extent individually possible, become productive in the economy. In addition, this consumer information has definite implications for pinpointing previously unforeseen problems as they pertain to housing and social barriers. This increased understanding of their experience in "being normalized" has the potential of facilitating and increasing our communication with and understanding of retarded people.

182 Evaluation of Retarded Student Achievement in Career Education Programs

Principal Investigator:	**Larry K. Irvin, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1976-August 1978**	
Cost:	**Annual $90,606** **RT Annual $4,839**	**Projected Total $175,000** **RT % of Annual Total 5%**
Annual Report Reference:	**#12, Page 40, R-43**	

OBJECTIVES: The primary purpose of this project is to examine the reliability and validity of testing approaches (using true/false and multiple choice item formats) and a rating approach for testing important student behaviors within career education programs for the mentally retarded. Six specific objectives have been identified.

Predictor Instrumentation

1. Development of preliminary three-option multiple-choice formats
2. Refinement of revised multiple-choice forms and development of two-choice forms
3. Comparison of reliability of alternate formats (true/false, and two-option and three-option multiple-choice)
4. Development of behavior rating instrument

Criterion Validity

5. Development of applied performance criterion instrument
6. Comparison of the validity of alternate forms of item formats within knowledge tests, and of alternate methods of measurement (knowledge testing and behavior rating)

METHODOLOGY:

1. Development of Preliminary Multiple-Choice Formats. Multiple-choice versions of three of the original nine SPIB tests were constructed, using the existing Social and Prevocational Information Battery (SPIB) items as guidelines for content. Prior to piloting with students, all items underwent expert review and appropriate revisions were made. Through counter-balanced presentation of 3 of the possible 4 options to each student, 3-choice versions were field tested.

2a. Refinement of Preliminary Forms. Three hundred thirty students from high school EMR classrooms in Oregon, Washington, California, and Texas were tested on the preliminary 48- to 54-item version of each multiple-choice test. Demographic information was also collected. Item difficulty levels, option frequencies, and item/test correlations were calculated for each item. Total test statistics, including average inter-item correlations and Coefficient Alpha internal consistency reliabilities were calculated. Tests were also inspected regarding the representation of content and subcontent areas within each test.

Based upon these analyses, revised tests were constructed containing 46-50 items. Each of the retained items also underwent distractor analysis in order to permit the empirical selection of the two most plausible incorrect alternatives.

2b. Development of 2-Choice Forms. Three hundred twenty-three students from high school EMR classes were administered the revised 3-choice item sets. The demographic characteristics of this sample were nearly identical to those of the earlier group. Item difficulty levels, option frequencies, item/total test correlations, and total test statistics were calculated.

Based upon the resutls of these item, test and content analyses, 40- to 41-item tests were derived. Distractor analyses resulted in the empirical development of 2-option tests by the exclusion of the least plausible incorrect alternative from each retained item.

3. Comparison of reliability of alternate Item Formats. Four hundred twenty-five high school EMR students were again tested on two formats out of three: two-option multiple-choice, three option multiple-choice, or the original true/false form of each of three tests. In order to control for effects of practice, the order of administering the two forms of each test was systematically varied. Item difficulty levels and item/test correlations will be calculated for each item within each form of each test, in order to ascertain the impact of item revision. Finally, means, standard deviations, and measures of internal consistency will be determined for each form of each test and also for subsamples, using the demographic variables as stratifiers.

4. Development of Behavior Rating Instrument. The original SPIB content area structure was used to construct this second major type of predictor instrument for each of the three SPIB tests selected. Concurrently with the knowledge test administrations, a subsample of 147 parents of students who had taken two forms of the knowledge tests was administered the behavior rating instrument. Analyses of the psychometric properties of the behavior rating instrument, such as those previously outlined in relation to the knowledge tests, will be performed for this instrument. In addition, validity analyses will be carried out, including the computation of intercorrelations of the behavior rating measure with all other instruments used, as well as multiple regression analyses. Through the multiple regression analyses, a predictor set that includes both the knowledge and the behavior rating approaches was investigated in terms of its power to predict performance. Finally, cross-validation of the resulting multiple correlations will be completed.

5. Development of Applied Performance Criterion Validity Instrument. The criterion instrument developed is an individually administered applied performance test (APT) in each of the three content areas identified above. The applied performance test was pilot tested with three groups of mildly mentally retarded persons. Results of pilot testing were generally positive, and appropriate revisions were made in the tests on the basis of these results prior to administration to project subjects. The Purchasing test has 23 scorable items, and both the Job Search test and the Banking tests contain 28 items each. The measure consists largely of actual and simulated real-life types of activities and materials. Administration of the total APT required approximately one hour per subject.

Basic descriptive statistics characterizing the applied performance tests as instruments will be calculated, including means, average difficulty levels, standard deviations, and internal consistency reliability estimates.

6. Comparison of Criterion Validity of Alternate Predictor Formats. As concurrently as possible with the administration of predictor instruments, a subsample of the total project sample (students who had taken two forms of the knowledge tests and whose parents had responded to the behavior rating scale) was administered the criterion instrument on an individual basis.

These procedures eventually produced 156 completed protocols, including two knowledge test scores, a behavior rating score, and an applied performance score within all three content areas. Since only two-thirds of this sample took any given form of the knowledge tests, the comparative validity studies have an upward limit of approximately 100 subjects, with the number of subjects available for any given analysis ranging from 71 to 99.

In order to investigate the research question concerning the differential validity of alternate item formats within the general method of knowledge testing, single-order correlations and simple regressions of item formats upon aplied performance will be calculated. Intercorrelations among all five instruments will be determined, as well as multiple correlations in which knowledge with behavior ratings will be regressed upon applied performance.

Cross-validation procedures will then be carried out in order to estimate the degree of shrinkage of the obtained simple and multiple correlations to be expected should these regression weights be applied to scores obtained by other samples.

FINDINGS TO DATE:

1. Development of Preliminary Multiple-Choice Formats. Initial pilot forms of the multiple-choice tests obtained from 48-54 three-choice items. One content and two statistical criteria were established in order to guide the process of item elimination. Desirable statistical properties of items included the presence of difficulty levels not greater than .95 nor less than .30, and item/total test correlations above .15. At the same time, care was taken to maintain adequate representation of the various content and subcontent areas within each test.

   As a result of test and item analyses guided by these three principles, the revised pilot forms of the three tests contained from 46-50 items per test.

   Mean difficulties of each of the three initial pilot tests were between 60% and 65%, thus approaching the optimal difficulty level of halfway between chance level of maximum score. Standard deviations ranged from 7.4 to 9.1 for sets of approximately 50 items in each test. The average inter-item correlations ranged from .08 to .13 for the three tests, and coefficient alpha internal consistency estimates exceeded $r_{\alpha} = .80$ for all tests.

2a. Refinement of Multiple-Choice Forms. Using the item analysis criteria outlined in Objective 1 above, 40- to 41-item tests were derived. The following overall test statistics were achieved for each test following elimination of unsuitable items: average interitem correlations of .08 or greater, coefficient alpha internal consistency reliability estimates of .80 or greater, and overall test difficulties of 58 to 68% of total items correct. Standard deviations ranged from 6.8 to 10.6 for resulting sets of 46-50 items per test.

2b. Development of Two-Option Multiple-Choice Forms. Given the development of psychometrically sound item sets following these two pilot studies, two-option forms were developed empirically within each test. The criterion for selection of a two-choice item form consisted simply of degree of plausibility of distractors. Thus, the least plausible of the two distractors that had been administered in both pilot administrations was excluded from the two-alternative multiple-choice version of each item within each of the three tests. The resulting two-choice multiple-choice tests were exactly parallel in content to the three-choice tests, except that only one of the two incorrect alternatives from the three-choice items was included in the two-choice items.

   Final analyses of the reliabilities, intercorrelations and predictive validity of the instruments are now under way. Cross-validations of the regressions will also be performed.

APPLICABILITY: There is a large user population for assessment instruments and strategies for career education programs for mildly retarded citizens. Educators and vocational rehabilitation professionals consistently voice needs for appropriate measurement tools. Effective programming and placement decisions can result only from precise measurement strategies that are designed to assess specific program components. By exploring test formats that may be appropriate for student evaluation in career education programs, this project can leave us with a measurement strategy that can be used appropriately by all who are involved in the education and vocational rehabilitation of mildly retarded citizens.

183 Pilot Study on Overdependence in Mildly Retarded Adolescents: A Structural Family Therapy Analysis

Principal Investigator:	**Philip Browning, Ph.D.**	
Status:	**New**	
Dates:	**March 1977-February 1979**	
Cost:	**Annual $12,198** **RT Annual $12,198**	**Projected Total $10,666** **RT % of Annual Total 100%**
Annual Report Reference:	**#12, Page 124, R-45**	

OBJECTIVES:

1. The identification and analysis of behavior variables which correlate with overdependence and with independence in mildly retarded adolescents;
2. The identification and analysis of parental behavior variables which correlate with overdependence and with dependence in mildly retarded adolescents;
3. The development of a direction for further research on overdependence and independence within a family context. If any family variables are found to correlate with overdependence or

independence, further attempts to investigate these concepts in a family context would be warranted; and

4. The development of a videotape to educate mental retardation personnel on the family dynamics of overdependence and independence and to instruct them on family behaviors existing concurrently with overdependence and independence. Implications for intervention procedures that minimize overdependence will be developed.

METHODOLOGY: Thirty subjects will be selected from clients of the Lane County Department of Vocational Rehabilitation based on scores from the Adaptive Behavior Scale and the Highlands Dependency Questionnaire. Fifteen subjects will be placed in each group appropriately (Independent or Overdependent). Two instruments have been developed to determine or identify dependence and independence in mentally retarded adolescents still living with their families. On the basis of these tests, families are asked to consider a one-time Family Problem-Solving Session which consists of the family's identifying a family problem concerning the adolescent and attempting to reach a consensus within 30 minutes on how to solve this problem. Each 30-minute family session is videotaped and coded. Three analyses will be done on the data collected:

1. Dependent and independent mildly retarded adolescents (between subject's factor) will be compared on each of the nine dependent variables (repeated measure) by way of a two-way analysis of variance using a total per category per adolescent;
2. Parents (between subject's factor) of dependent and of independent mildly retarded adolescents will be compared on each of the 12 dependent variables (repeated measure) by way of a two-way analysis of variance using an average per category per parent; and
3. Correlations will be done of all parent behaviors with all adolescent behaviors for dependent and independent groups separately to determine whether relationships are similar or different. If relationships are similar, it may be necessary to look at absolute frequency means and standard deviations to assess differences.

FINDINGS TO DATE: This project is still in the very early stages and no significant reporting is available to date.

APPLICABILITY: The numbers of retarded persons remaining overdependent upon their families and other social institutions throughout their lives, in spite of their receiving comprehensive rehabilitation services, undermines the success of rehabilitation programs. An understanding of overdependence as part of a total family interaction pattern should provide a direction to the rehablilitation professionals for the efficient and effective use of time and resources.

184 Evaluation and Training of Severely/Profoundly Retarded Adults for Community Adjustment

Principal Investigator:	**Daniel Close, Ph.D.**	
Status:	**New**	
Dates:	**September 1977-August 1980**	
Cost:	**Annual $82,457** **RT Annual $82,457***	**Projected Total $200,000** **RT % of Annual 10%**
Annual Report Reference:	**#12, Page 80, R-47**	

***Funded primarily by Bureau for Education of the Handicapped, U. S. Office of Education.**

OBJECTIVES:

1. Development of an Assessment Instrument, for use with severely and profoundly retarded individuals in residential settings, in the content areas of mobility, communication, self-care, and domestic skills.
2. Validation of the Assessment Instrument.
3. Development and Evaluation of a Comprehensive Assessment **and** Training Kit
4. Dissemination of Project Findings.

University of Oregon

METHODOLOGY:

1a. Determine content of the preliminary form of the assessment instrument by observing and recording behavioral repertoires of severely handicapped individuals successfully placed in community residences.

1b. Comparison of skills observed to existing Behavioral checklists such as the Camelot Scale, Nebraska Client Progress System, Adult Progress Record.

1c. Translate assessment scale content into prototype test items to comprise Pilot form of Scale.

1d. Field test pilot form of scale to standardize test procedures and validate item selection.

2a. Administer pilot form of scale to severely handicapped persons living in community residences.

2b. Observe client behavior in home setting to validate assessment scale.

3a. Develop administration manual for assessment scale.

3b. Development of skill training programs to teach content of the scale.

4a. Disseminate the assessment and training materials through RT Center's information distribution mechanism.

4b. Implement a series of short-term workshops to teach use of the kit to rehabilitation personnel.

4c. Publish project findings in professional journals and present project findings at regional and national professional conferences.

FINDINGS TO DATE: None, project is new.

APPLICABILITY: The instruments, manuals, and training kit produced by the proposed project will be developed specifically for use in the rehabilitation of severely and profoundly retarded persons. This system will allow program managers to use evaluative information to estimate the amount of time and resources needed to develop client skills to an acceptable level. The information obtained from the assessment instrument will facilitate the habilitation of severely/profoundly retarded people because the training programs presented are directly related to the skills assessed and to the varying skill levels observed. This will aid program managers in individualizing program planning and monitoring progress in training activities. Skill deficits will be defined as service priorities instead of client deficiencies.

An added benefit of the proposed project is that the instruments, manuals, and training procedures will function as a self-contained training program for service providers and rehabilitation counselors. By informing the rehabilitation counselor of the necessary content and procedures needed to prepare severely/profoundly retarded clients for community adjustment, the entire rehabilitation process is facilitated. Rehabilitation counselors will further be able to use the training kit to train paraprofessional workers to deliver high quality assessment and habilitation services to severely and profoundly retarded clients.

DEAFNESS
RESEARCH
& TRAINING
CENTER

New York University (RT-17)
Deafness Rehabilitation Research and Training Center

CORE PROBLEM

Improving the Delivery of Services to Deaf People

CORE AREAS

Developing Models for Service Delivery

Determining the systems which most effectively and efficiently deliver services to deaf people.

Developing the Data Base

Gaining accurate information on the demographic characteristics of the deaf population, necessary for effective planning and delivery of social and rehabilitation services.

Communication Research

Proximal (face-to-face) communication and telecommunication (communication at a distance) with deaf persons.

Vocational Research and Development

Examination and development of work evaluation practices with deaf persons; examination of specific occupational factors which militate against the employment and promotion of deaf workers.

Deaf Community Development

Research and training projects designed to bring deaf consumers into more active and constructive roles in planning and delivery of services to the deaf community.

Personnel Research and Development

Examination of techniques to expand the reach of existing professionals to greater numbers of deaf clients and to facilitate the preparation of new personnel.

NEW YORK UNIVERSITY DEAFNESS CENTER

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PROJECT TITLES BY FY 1978 STATUS

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185 Continuing Assessment of Programs for Preparation of Professionals to Work with Deaf People

Principal Investigator: **Jerome Schein, Ph.D.**
Status: **Completed**
Dates: **September 1976-May 1977**
Cost: **Annual $13,800** **Projected Total $85,000**
RT Annual $10,350 **RT % of Annual Total 75%**
Annual Report Reference: **# 11, Page 12, R-10**

OBJECTIVES:

To provide continuous feedback to the Deafness Center training faculty on the strong and weak points in the curriculum.

To determine modifications in the curriculum which may be required by changes in the field.

To obtain projections of the demands for professional personnel.

METHODOLOGY: Since 1971, data have been assembled continuously on two groups: current students and graduates of the program. The Knowledge of Deafness Test and a proficiency test in American Sign Language (Communication Skills Assessment) were developed and administered to current students. Along with the Cowen and Siller Attitudes towards Deafness scales, the test battery was used to determine the knowledge, attitudes and skills of students before and after their training at New York University.

Annually, graduates are sent a mail questionnaire soliciting information about current employment. Evaluations of graduates are also obtained from supervisors.

FINDINGS TO DATE: Data from the assessment were directly applied in a major revision of the Deafness Center's graduate program curricula. As a result of reports from the field that deafness rehabilitation specialists were needed and from students that more specialized and detailed information about deafness was desired, the Deafness Center developed a new program leading to the Master's degree in Deafness Rehabilitation. The Deafness Center is currently assessing first-year results with the new program.

Feedback from former students and their employers led to the following specific innovations in the program: (1) incoming graduate trainees now spend one full week each fall in a sign language retreat to provide a total living-learning environment for rapid acquisition of manual communication skills. Findings to date indicate that the week-long program provides a solid foundation for students, facilitating their further acquisition of signs in regular Deafness Center manual communication classes, increasing their voluntary interaction with deaf people during the time they are students at New York University, and generating confidence in work with deaf people. Pre- and post-tests given regularly at the retreats demonstrate rapid and broad acquisition of signs. The question is now being investigated whether the short, intensive model of sign language instruction may be more helpful to many students than more piecemeal, distributed instruction. (2) Special telelectures have been arranged with nationally recognized authorities in deafness rehabilitation speaking to students on video-tapes. The lecture is followed by a direct two-way telephone hookup allowing students to question and respond to the speaker. This arrangement has proven highly successful in enabling students to come into contact with leaders in the field and to have their questions answered at the highest levels. For the busy administrator, the arrangement permits him to contact students directly without having to waste precious time in travel. (3) The Deafness Center has prepared a competency-based teacher education program in response to requests from the field and from students. The program has met with the approval of the New York State Education Department. (4) State directors of vocational rehabilitation agencies throughout the country have been contacted and requested to anticipate their personnel needs in order to ensure the relevance of the training to current needs in the field.

APPLICABILITY: Staff development at all levels requires evaluation. The instruments and procedures developed in this project can be used by other universities and agencies wishing to assess the capabilities of their staff and/or students in serving deaf people.

The results of the assessment have been applied directly to effect a major improvement in the quality of graduate training offered by the Deafness Center. The findings have been shared with other New York University faculty for their consideration. Reports in **The Deaf American** and other publications are expected to lead to changes in personnel preparation in other universities.

Information on both the Knowledge of Deafness Test and the Communication Skills Assessment has been given to interested training centers. Articles have appeared in professional publications.

186 Overcoming Barriers to Deaf Persons in Federal Government

Principal Investigator:	**Jerome D. Schein, Ph.D.**	
Status:	**Completed**	
Dates:	**April 1973-April 1977**	
Cost:	**Annual $6,250** **RT Annual $4,620**	**Projected Total $70,000** **RT % of Annual Total 74%**
Annual Report Reference:	**#11, Page 16, R-26**	

OBJECTIVES:

To improve deaf persons' opportunities to enter and be promoted fairly in federal government.

To develop a training program for supervisory personnel in government installations which will deal with specific problems of, and created by, deaf employees — a program designed to improve occupational conditions for deaf employees.

METHODOLOGY: The Civil Service Commission arranged for a study within two installations. Due to budgetary constraints, only one agency was studied, the Navy Printing Office, Arlington, Virginia.

A sample of jobs was selected, and entrance examinations and job requirements reviewed from the deaf applicant's perspective. Interviews with prospective applicants who are deaf were conducted. Selected occupations were reviewed for possible job tailoring to accommodate deaf workers. Deaf people already employed and their supervisors were interviewed to determine changes which could improve their productivity and job satisfaction.

FINDINGS TO DATE: During the first year of the project relations with the Civil Service Commission and the Navy Printing Office were established, the survey of entrance procedures and job descriptions completed and plans for the study of promotion procedures drawn up.

During the second year, interviews were held with deaf workers, promotion practices were surveyed and orientation to deafness seminars were conducted for supervisors.

During the project's third year activities were curtailed due to budgetary constraints. Recommendations emanating from the survey on entrance procedures are being drafted and will be forwarded to the Civil Service Commission. The survey of job conditions was also completed, with recommendations to be presented to the Civil Service Commission.

The initial pilot project report ("Barriers to the Full Employment of Deaf Persons in Federal Government," **Journal of Rehabilitation of the Deaf,** July, 1975, 1-15) noted that barriers rather than overt discrimination existed. The current project has not changed our perspectives. We remain convinced that appropriate training for supervisors, in conjunction with the guidelines of Section 501 of the Rehabilitation Act of 1973, will go a long way to overcoming barriers to employment and advancement of deaf people in federal government.

APPLICABILITY: The federal government is the largest employer in the nation. Its policies and practices influence industry. Any improvement of deaf persons' opportunities in federal employment should be reflected generally. The federal project also has potential for greater visibility and subsequent influence for good than any comparable local study. In addition, the willingness of the Civil Service Commission to participate in this project will improve the attitudes of the deaf community toward federal employment.

187 Development of Videotapes for Application in Training Rehabilitation Counselors to Work with Deaf Clients

Principal Investigator:	**Thomas Freebairn, Ed.M.**	
Status:	**Completed**	
Dates:	**September 1974-December 1977**	
Cost:	**Annual $15,910** **RT Annual $13,630**	**Projected Total $50,000** **RT % of Annual Total 86%**
Annual Report Reference:	**#11, Page 51, R-29**	

New York University Deafness Center

OBJECTIVES: To design, produce, and evaluate a series of pilot videotapes of counseling sessions with deaf clients for use in programs which train counselors to work with deaf people.

METHODOLOGY:

1. Variables to be considered as important in the videotapes include interview content (type of problem experienced by client), counselor fluency in the use of manual communication, and level of the client's use of language.
2. Representative counseling interview involving selected examples of client problems, characteristics, and related counselor-client interaction will be simulated on videotape. Due to the possible infringement upon client confidentiality which could occur with videotaping of "live" counseling interviews, professional deaf actors and actresses, or Deafness Center staff will simulate clients.
3. Following development of the script, rehearsals, and editing, a pilot videotape was made using the staff and facilities of the Deafness Center. It was expected that this approach would permit maximum refinement of the script prior to contracting with a professional studio to make final videotapes in a subsequent future project if funds become available.
4. Following this preliminary evaluation, refinements were made of all basic components. Script outlines were prepared for the entire series. The full series was then produced, edited and evaluated.

   The video-tape series was based on an adaptation of the Interpersonal Process Recall approach developed by Dr. N. Kagan.

   In evaluation, special attention was given to the following components: stimulus films, counselor-client simulations, interpersonal process recall sessions.

FINDINGS TO DATE: Preliminary scripts and introductions have been developed for six proposed videotapes. One 30 minute pilot tape using Deafness Center staff and facilities has been completed. Portions of these materials have been reviewed by the Deafness Center Advisory Board, by students in Deafness Center training programs and by other Deafness Center staff members. The evaluations have all been very enthusiastic, in each case including strong recommendations to develop the materials further and to explore arrangements for producing and distributing them for use by other counselor training programs around the country.

A video-tape series of the six initial tapes was produced and evaluated. The major components of the series, based on an adaptation of Kagan's Interpersonal Process Recall (IRP) method of counselor training, were evaluated. It was found that adaptation of the IPR method for training with deaf clients is necessary, especially with respect to demands on camera technique (to include both sign language and the facial expressions of client and counselor, for example), and that special attention must be paid to the nonverbal communication of a sign language interpreter and of the counselor. Further evidence was found by which specific production and training modifications should be guided.

Tapes were rated positively as to clarity, readability, content, personal reactions, and motivation. While speechreading was difficult, sign language was clear. Tapes are available at cost. Literal captions will be provided pending further funding of the project.

APPLICABILITY: Rehabilitation counselors are the coordinators of rehabilitation services. Consequently, their ability to communicate with and provide effective counseling to deaf clients is a critical aspect of the total rehabilitation program.

The tape and materials are expected to prove especially useful in orientation-to-deafness seminars for rehabilitation counselors, and in classroom work of students in rehabilitation counseling programs at NYU. This application will provide effective field evaluation of the materials. A future project, if funded, would produce the final materials in suitable form (videotape or film) and make the master copies available for duplication and distribution to other training programs.

Copies of the completed series of video-tapes are available on an at-cost basis in order to reach counselor training programs, graduates and undergraduates in the fields of deafness and/or rehabilitation. At-cost copies are available also to all state vocational rehabilitation agencies, and Rehabilitation Continuing Education Programs in order to reach ongoing inservice training activities.

It is anticipated that the series of video-tapes will help to fill the urgent need of counselors and counselor trainees for visual materials regarding counseling with deaf clients. If the series is used properly, we expect that the students will make substantial improvements in their counseling techniques with deaf clients. We also anticipate that the final plan for utilizing the tapes within training programs will serve as a model for later introduction of other media and materials.

New York University Deafness Center

188 Career Development for Deaf People: Normal Communication Specialist

Principal Investigator:	**Jerome D. Schein, Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1976-August 1978**	
Cost:	**Annual $58,200** **RT Annual $45,000**	**Projected Total $132,000** **RT % of Annual Total 77%**
Annual Report Reference:	**#11, Page 68, R-49**	

OBJECTIVES: To evaluate the adequacy of preparation for Nonoral Communication Specialists (NCS), whose services will aid clients who, like most prevocationally deaf people, may have adequate verbal skills but poor control of the vocal mechanism, with the result that their poor communication skills hinder their employment.

To evaluate the effectiveness of Nonoral Communication Specialists in working with various disability groups; e.g., mentally retarded, autistic, aphasic, schizophrenic.

To determine the extent of the job market for Nonoral Communication Specialists.

To investigate potential barriers to employment of Nonoral Communication Specialists and develop appropriate countermeasures.

METHODOLOGY:

1. NCS applicants were selected from among prevocationally deaf persons who were between the ages of 18 and 50 years; had at least a high school equivalency but not a college degree; were under- or unemployed; showed adequate manual communication skills, interest, and motivation.
2. A sample of five institutional settings, including a hospital, developmental center, and public school, was selected for the practicum part of the training.
3. The NCS training program begins with an introduction to the disability groups trainees may encounter: autism, aphasia, schizophrenia, cerebral palsy, and mental retardation. Consideration of each diagnostic category is divided into discussion (60), reading (10), and observation (30). The ethical principles and interprofessional relations an NCS must learn are strongly emphasized pre-practicum and during the practicum. Techniques of manual communication are thoroughly reviewed. Principles of instruction are discussed and practiced in the classroom. On completion of the didactic portion of the program, trainees enter a carefully supervised four-month practicum.

   During the first year of the program, trainees rotated through various settings. At the request of trainees and practicum administrators, however, this arrangement was modified for the second year to one setting per trainee for the full four months, so as to enable more time for training after establishing rapport, learning the facility's routine, and becoming acquainted with persons to be served.
4. Data from the following sources were analyzed: trainees' application forms, providing basic demographic and attitudinal data; trainee logs of practicum experiences; periodic interviews of institutional supervisors; supervisors' individual trainee and general program evaluations made at the end of the training period; the coordinator's ongoing individual trainee records.

FINDINGS TO DATE: The following conclusions serve to summarize the detailed findings upon which they are based.

1. The NCS concept is viable. Deaf people can, with proper training, fill a useful role in treatment of aphasic patients, autistic children, some cerebral palsied persons, and mentally retarded persons.
2. The job potential in this field exists for deaf persons.
3. Length of training should be increased. Probably an Associate of Arts (A.A.) degree should be developed. Content to be increased relates to specific disabilities and to methods and materials of instruction. Practicum assignments should be 2-4 months per setting.
4. NCS trainees need heavy emphasis on how to cope with such bureaucratic structures as tend to be in hospitals.
5. Current budgetary constraints on most health-care and educational facilities will prevent rapid addition of NCS personnel. Hence, substantial lead time should be sought before assigning trainees to practicum sites. With sufficient time to secure funds, three of the institutions in this study indicated they would hire one or more of the trainees assigned to them.

6. The fact that manual communication is effective with the afflicted individuals served by the NCS trainees in this study is consistent with findings being reported with increasing frequency. However, the ability of **deaf** persons to provide the manual communication to these **nondeaf** disabled persons has not previously been demonstrated—nor has it apparently been considered. That the deaf NCS can successfully teach manual communication to aphasic, autistic, mentally retarded and cerebral palsied persons has been demonstrated.

APPLICABILITY: This project has value in opening a career for deaf people in the helping professions—an area in which they have been sparsely represented. The resulting jobs should increase the number and quality of rehabilitations.

Secondly, the project has some paradigmatic value. It illustrates an approach to job development which may be successfully applied to further activities on behalf of deaf clients and to other disability groups. For vocational rehabilitation, service delivery culminates in appropriate job placement. Too often, deaf clients have been assigned to jobs below their vocational potential. This project aims to turn a formerly disabling characteristic into an occupational asset: to find profitable uses for manual communication. By means of this example, other projects may be stimulated which will improve the occupational status of deaf citizens.

189 Economic Status of Deaf Adults

Principal Investigator: **Jerome D. Schein, Ph.D.**
Status: **Continuing**
Dates: **September 1976-August 1978**
Cost: **Annual $109,000** **Projected Total $125,000**
RT Annual $81,200 **RT % of Annual Total 74%**
Annual Report Reference: **#11, Page 78, R-50**

OBJECTIVES: This study proposes to follow-up early 1977 the 1972 National Census of the Deaf Population (NCDP) sample to assess their experiences with the ongoing economic recession.

The primary purpose of the Economic Conditions Survey is to collect up-to-date facts about the number of deaf persons in the country who are employed, unemployed, or not in the market for jobs.

A further aim is to provide information as to the characteristics of greatest importance in dealing with the unemployed—their sex, race, age, how long they have been looking for work and what their last jobs were, the kind of work deaf people are doing and how many hours they work (essential for judging the economic condition of the deaf community), and the personal and family income of deaf adults as well as the sources of such income.

METHODOLOGY: The target population was defined, in the 1972 study, as those persons who cannot hear and understand speech when spoken directly into their ear, such impairment having been suffered prior to 19 years of age. This group is referred to here as the prevocationally deaf population.

A panel technique was employed to study changes over time with respect to the 1972 study. The sample included individuals involved in the earlier study and was obtained by means of a multistage cluster sampling technique with stratification.

Questionnaire design was based on the self-administered format. Categories of information tapped included demographic characteristics, hearing ability, occupation and work experience, income, education, experience with department of vocational rehabilitation, and geographic mobility. The procedure included pretesting of the questionnaire and an interview follow-up in order to pilot survey procedures; follow-up of nonrespondents; and descriptive and analytic data analysis.

FINDINGS TO DATE: Findings support the general conclusion that deaf adults have suffered disproportionately from economic conditions over the past half dozen years. Employment is down; relative earnings have dropped. The economic status of the deaf population has greatly deteriorated.

Detailed findings included the following:

1. A higher proportion of deaf workers was not in the civilian labor force during 1977, as compared with the proportion of deaf workers out of the civilian labor force during 1971.
2. With some qualifications, a higher proportion of deaf workers was unemployed during 1977

than 1972; a lesser proportion of deaf workers was employed during 1977 than 1972.

3. The proportion of deaf males residing in or heading a household with government-supported family income was higher in 1976 than in 1971.
4. Personal income of deaf workers has declined from 1971 to 1976, relative to the general population.
5. The difference in family income between workers in the general population and deaf workers has increased from 1971 to 1976.

It is estimated, moreover, that the extent of the economic decline is even greater than survey results would indicate, due to an upward bias in the socioeconomic characteristics of those who responded. The present respondents, though generally representative of the deaf population, tended to be educationally and occupationally better off.

APPLICABILITY: Results are expected to provide a solid data base for VR agency administrators to use in designing and modifying state plans for rehabilitation of deaf clients. Project results will be especially useful to policy makers in rehabilitation at the federal, regional and state levels. Federal and state administrators will want to know the specific implications of this project upon delivery of services to deaf clients under their jurisdiction. Probably of immediate concern in this regard is: (1) the displaced deaf worker; (2) the direction which training for deaf clients should take; (3) the deaf worker during a time of national economic crisis, and (4) how state VR agencies can plan for anticipated deaf caseloads.

The results may be useful to professionals working with other disability groups.

Deaf consumers and their leaders as well as other handicapped consumers can use project findings for advocacy purposes.

190 Survey of Personnel Needs in Deafness Rehabilitation

Principal Investigator:	**Jerome D. Schein, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1976-August 1978**	
Cost:	**Annual $61,610** **RT Annual $46,010**	**Projected Total $110,000** **RT % of Annual Total 75%**
Annual Report Reference:	**#11, Page 100, R-51**	

OBJECTIVES:

1. To produce annual projections of rehabilitation clients from the deaf population for the period 1976-1985.
2. To estimate professional and paraprofessional manpower needs in deafness rehabilitation for the period 1976-1985.

For the purposes of this study, the target population is defined as those persons who cannot hear and understand speech when spoken directly into their better ear, and who are between the ages of 16-64 years.

METHODOLOGY: Meeting the twin objectives of this study will require step-by-step treatment of two data baselines: 1) estimating the number of deaf service seekers and 2) estimating the number of deafness service provides. A key procedure then becomes the convergence of these two baselines through the following ratio and rate statistics:

Objective 1. Deafness Rehabilitation Clientele 1976-1985

a. Estimating the size of the general population over the next ten years from Series D of the Bureau of Census estimates.

b. Determining the annual magnitudes of the deaf population to 1985 by applying prevalence rates to the general population data. Rates will be derived from the 1972 National Census of the Deaf Population.

a. and b. Treatment of demographic data on general and deaf populations in terms of ratios with general population data considered dynamic and deaf population rates remaining constant.

c. Distributions of the deaf population across salient variables will be developed. These characteristics include sex, age, race, and geographic location.

d. Estimating the number of deaf service seekers through questions incorporated into the 1977

Economic Conditions Survey.

Objective 2. Estimates of Deafness Rehabilitation Manpower Requirements (1976-1985)

a. Obtaining the cooperation of key organizations to provide input into the Personnel Needs Survey. Prospective groups include: American Deafness and Rehabilitation Assoc. (formerly PRWAD), CSAVR, RSA, Registry of Interpreters of the Deaf, National Assoc. of the Deaf, National Association of Social Workers (Committee on Hearing Impaired), and universities and colleges with paraprofessional or graduate training programs in deafness rehabilitation.

b. Types of data needed will be derived from surveys directed to administrators of vocational rehabilitation in 54 states and territories, directors of graduate training programs in deafness rehabilitation, and directors of approximately 75 public and private service facilities.

Convergence of Treating Data from Objective 1 and Objective 2.

A key working statistic in the convergence of data baselines which can project DVR staff requirements will be the consequence of treating data on the number of deaf service seekers and the number of deafness rehabilitation service providers. The anticipated ratios will be calculated as follows:

$$\text{Anticipated ratio} - \frac{\text{Number of deaf service seekers}}{\text{Number of deafness service providers}}$$

Assessing variables that may influence rates of participation by deaf applicants to DVR. There are two major categories of such variables:

a. demographic characteristics of the deaf population

b. rehabilitation resources

Data will be collected by mail and will include the questionnaire, cover letter, and post paid return envelope. Data processing will involve a multistage operation with coding and keypunching both containing 100% verification. A detailed coding manual will be prepared for each of the three questionnaires. A quality control check will be made on all data which is reduced and coded. In no instance will coders be assigned to checking their own coded material. Data will be keypunched from transcription sheets to 80-column IBM cards for processing. A 100% key-verification will assure accuracy of keypunching. Impossible and improbable checks will be run to eliminate any errors that may have filtered through.

FINDINGS TO DATE: Project efforts since September 1976, have focused primarily upon developing refinements in the methodology of the study: a broad review of the professional literature has been completed and specific attention has been given to elucidating procedures for treatment of project data.

APPLICABILITY: RSA Research & Evaluation Strategy for FY '77 and '78 notes the following under the highest priority (Development of New Knowledge) for Sensory Disabilities:

"D.4. To conduct cost-benefit and staffing surveys related to the sensory handicapped."

This study will contribute information essential to assessing the personnel needs of the hearing handcapped.

191 Tailoring Captions for Deaf Audiences

Principal Investigator:	**Alan L. Stewart, Ph.D.**	
Status:	**Continuing**	
Dates:	**September 1976-October 1980**	
Cost:	**Annual $34,800** **RT Annual $26,200**	**Projected Total $67,500** **RT % of Annual Total 75%**
Annual Report Reference:	**#11, Page 111, R-52**	

OBJECTIVES: This project's immediate objectives are, first, to validate the existence of consistent differences among deaf viewers in the way in which they process fingerspelled and printed captions; and, second, to find additional correlates of differences in performance on these two tasks such as to maximize prediction of the fit of each captioning technique to a variety of target audiences. These efforts represent part of our commitment to the ultimate goal of specifying well-formulated guidelines by which each captioning technique can best be adapted to meet the cognitive needs of groups of deaf viewers whose characteristic modes of processing linguistic input differ. Only in this way can the instructional and rehabilitative benefits of captioned material be extended to all members of the deaf community.

METHODOLOGY: Conrad (British Journal of Psychology, 1972) has documented some evidence of differences among deaf children in their cognitive styles, in that some deaf children confuse letter sequences which sould alike, while other deaf children do not; rather, the children in the latter category confuse sequences of letters which look alike. Attributing a characteristic cognitive strategy to a particular deaf child implies that there should be some generality of coding preferences, within this same individual, across the different types of linguistic material available to him. While this assumption has been implicit in studies reported by Conrad, for example, it has not been studied directly.

Results of our previous experimentation indicate that deaf viewers may differ in the way in which they habitually process and store visually presented information. Some deaf viewers seemed to process both strings of fingerspelled letters and pairs of printed letters by means of a quasi-auditory or phonic code, while other deaf viewers seemed to emphasize visual codes. If it can be shown that there are stable differences among deaf viewers in their emphasis on one of two styles of processing visually presented cognitive material, then instructional material in general and, more particularly, captioned instructional material, can be optimized for each of these two kinds of visual processors.

More specifically, in the studies being conducted, variations in reaction time (RT) to matching pairs of visually presented letters are measured as a reflection of differences in the coding strategies employed. In this task, first investigated extensively by M. Posner, subjects identify two letters as being the same when they are physically identical, as in the letters **AA,** or when they are of different case but nominally the same, as in **Aa**. In the seminal study by Posner, the occurrence with hearing subjects of faster RT's to physical than to name matches suggested that coding strategies might have differed according to the kind of similarity between the two letters within a pair. It was reasoned that, while for the same-case letter pair (**a physical match**) a visual coding strategy was possible, the mixed-case pair (or **name match**) required some other, perhaps verbal, type of code in order for the two visually dissimilar stimuli to be identified as representing the same letter. Hence, performance on Posner-like tasks are now being related to the performance of deaf people on recall of fingerspelled letters.

FINDINGS TO DATE: Subjects may in fact differ in the coding strategy which they emphasize in the Posner task, some subjects tending to code both physical and name matches verbally, others using verbal codes only for name matches. Differences among deaf subjects were found in their performance on both the Posner task and in their recall of sequentially presented fingerspelled letters. Deaf subjects whose report of sequences of fingerspelled letters produced bow-shaped serial position curves, of the type typically found among hearing subjects with auditory short term memory, had longer RT's to both types of matches on the Posner task, with a comparatively small difference in time to the two types of matches. Other subjects showed monotone decreasing serial position curves, more common with visual short-term memory, on the fingerspelling task, and larger elevations in RT to name matches .

APPLICABILITY: Many deaf rehabilitation clients do not develop a full linguistic competence of which they are capable. Performance of the same linguistic task may require a different hierarchy of skill development for people who differ in means of visually processing linguistic information. Instructional approaches and the visual supplements which are employed can truly serve their functions only when we have the knowledge necessary to adapt both technique and material to the characteristics of the individual.

192 Fatigue in Visual Communication

Principal Investigator: **Alan L. Stewart, Ph.D.**
Status: **Continuing**
Dates: **September 1976-August 1978**
Cost: **Annual $47,800** **Projected Total (not specified)**
RT Annual $35,500 **RT % of Annual Total 74%**
Annual Report Reference: **#11, Page 124, R-53**

OBJECTIVES: The studies currently undertaken are concerned with understanding how visual information is processed and discovering how deaf observers can most effectively use all of the visual information available to them. Research is directed at the discovery of principles which will facilitate designing efficient displays of visual information, and may in turn help us understand how deaf viewers can best be trained to analyze and extract the information available within their visual environment.

METHODOLOGY: Our research strategy entails two complementary approaches. We have been combining a mathematical approach with the principles of systems analysis in order to devise a model by which we can calculate the interference effects due to the interaction of the set of design characteristics with the visual system of the observer. In the terms employed in systems design, we expect that the mathematical model which we are developing will tell us how the psychophysical product will vary as a function of the interaction of the complex set of elements in the physical display and the visual and cognitive characteristics of the observer. At the same time, we are employing an empirical approach which involves the systematic investigation of the perception of visual displays, the physical parameters of which have been varied in accordance with standard psychophysical procedures. This second approach is complementary to the first in that we are seeking to test the validity of our mathematical model at each stage of its development.

The concept of a transfer function has been shown to be useful in engineering studies of television as well as to other display devices. It has also been shown that the best transmission system for displays of static material are those whose transfer functions most closely match that of the human visual system. In order to understand how the human observer handles visual information that varies over time, as it does with fingerspelling or television captions, however, these concepts must be generalized to both spatial and temporal dimensions. These generalizations are now being undertaken through the application of systems analysis.

FINDINGS TO DATE: Reducing the overall level of illumination to some moderate level improves visual performance. But reducing the target energy, by itself, is not an effective means of eliminating all visual interference, since forward interference effects become more pronounced than backward effects as the level of illumination is lowered. Therefore, determining the optimal tradeoff in the absolute level of illumination of dynamic stimuli which will minimize forward and backward interference effects must await a detailed and well-developed model of visual information processing.

APPLICABILITY: Final results of this research will be of use to a broad range of people. They will be of use to decision makers, who must determine how instructional materials are to be delivered to deaf people—via television, film, or through text books. They will be particularly useful in deciding if instructional material on television or films should be captioned with literal, written captions or by means of manual communication, because the answer depends, in part, on how well television transmits the critical elements of such dynamic visual displays. They will also have much to contribute to decisions on the rate at which information can be delivered optimally via films and television as well as in interpersonal instructional settings. The results should also prove to be useful in systematic and programmatic investigations of the traits and abilities which underlie successful lip reading and manual communication.

UAB

University of Alabama in Birmingham (RT-19)
Medical Rehabilitation Research and Training Center

CORE AREAS

Spinal Cord Injury

Projects intended to impact upon the specific course of care as well as influence eventual rehabilitation outcomes of victims of this catastrophic condition. Studies address therapeutic agents, various treatment modalities and basic research questions — each intended to fill voids in knowledge gaps so as to improve the rehabilitation outlook and potential for the spinal cord injured patient. Activities are designed to provide the professional and scientific community with data and findings applicable to medical and vocational programs.

Metabolic Effects of Severe Disability in Both Static and Dynamic Conditions

Activities addressing physical disability globally, by measuring, assessing and evaluating the disability component of a broad spectrum of conditions and/or diseases.

Assessment of Long-Term Needs of the Severely Physically Handicapped

Activities designed to lead toward the development of definitive information essential to the development of strategies to prevent the occurrence of costly interruptions to successful rehabilitation and to provide necessary services which will be readily available throughout the patient's entire lifetime.

Biocommunications

Continuing research designed to create and disseminate a vast new body of knowledge relative to the process of oral communication resulting in a continual increase in the understanding of the physiologic and anatomic basis of problems — leading to the development of corrective therapeutic modalities. Knowledge and skills growing out of this work will markedly improve the patient/client's ability to participate successfully in a vocational rehabilitation program.

UNIVERSITY OF ALABAMA IN BIRMINGHAM

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University of Alabama Medical
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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

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Physiology of Vowel Production by Normal and Deaf Speakers

University of Alabama in Birmingham

193 Evaluation of Long-term Urinary Sterilization in Catheter-Free Paraplegics

Principal investigator:	**Samuel L. Stover, M.D.**	
Status:	**Completed**	
Dates:	**June 1973-December 1977**	
Cost:	**Annual $ (not specified)** **RT Annual (not specified)**	**Projected Total $52,114** **RT % of Annual Total 44%**
Annual Report Reference:	**# 12, Page 85, R-37**	

OBJECTIVES:

1. To determine the length of time patients with complete spinal cord injury (SCI) continue to have sterile urine after appropriate antibiotic therapy and during prophalactic trials with both methenamine hippurate (hiprex) and ascorbic acid;
2. To compare the effectiveness of methenamine hippurate to ascorbic acid in 100 patients with complete SCI in a random study.

METHODOLOGY:

Spinal cord injury patients with complete neurological loss below the level of injury and no signs of chronic renal insufficiency constitute the study population. Subsequent to initiation of an intermittent catheterization program (ICP), 2 urine cultures will be obtained. Antibiotic treatment is given for 7 to 10 days to acquire a sterile urine. During the same time patients are randomly placed on either methenamine hippurate or ascorbic acid. Urine specimens are considered sterile if the colony count is $<$1000 colonies/ml. If sterile urine is not obtained, the patient is dropped from the study. Urine pH is checked daily and both groups are evaluated for urine pH of 6.0 or less. Follow-up urine cultures, colony counts and sensitivities are performed weekly while patients are hospitalized and at approximately 1, 2 and 6 month intervals following discharge. Recurrence of bacteriuria results in discontinuation of the patient from the study. Patients receiving methenamine hippurate who have maintained sterile urine for 6 months then have the drug discontinued. The patient is followed for recurrence. Patients experiencing recurrent bacteriuria on 2 consecutive cultures receive appropriate antibiotic therapy determined by standard sensitivity techniques and may again be randomized into a treatment or control group. Data are analyzed to determine whether a statistically significant difference in the incidence of bacteriuria exists between those treated with methenamine hippurate or ascorbic acid.

FINDINGS TO DATE: 100 patients have participated in the study. 51 patients received ascorbic acid; 49 patients received methenamine hippurate. Of the 49 receiving methenamine hippurate, 20 continued with a sterile urine for more than 4 weeks. 7 continued to have sterile urine for 6 months or more. Of 51 patients receiving ascorbic acid, only 2 maintained sterile urine for more than 4 weeks. These data suggest methenamine hippurate is more effective than ascorbic acid in preventing relapse and reinfection of the urinary tract in patients who have sustained complete neurological lesions. It is recognized that patients receiving methenamine hippurate treatment in this study cannot be compared to patients who would not receive any drug therapy at all; however, there is increasing evidence ascorbic acid has very little effect in preventing relapse or reinfection and its action seems comparable to the absence of drug therapy.

APPLICABILITY: The ultimate goals of an ICP include removal of the indwelling catheter and maintenance of a sterile urine. If methenamine hippurate is effective in the maintenance of a sterile urine and the prevention of recurrent urinary tract infections, its cost would obviously be justified. In addition, the dosage regime seems far more acceptable to the patient than the regime required of ascorbic acid. Recurrent urinary tract infections are one of the most frequent reasons for repeated hospitalization and also lead to recurrent urinary tract calculi which often require hospitalization and surgery. Any method of therapy which assists in maintenance of a sterile urine will be invaluable in the prevention of renal deterioration, will decrease the cost of repeated hospitalization and will permit the patient to continue pursuing vocational objectives.

University of Alabama in Birmingham

194 Localization of Urinary Tract Infection by Identifying Bacterial Antibody-Coating with Immunofluorescence

Principal Investigator:	**Samuel L. Stover, M.D.**	
Status:	**Completed**	
Dates:	**January 1975-December 1977**	
Cost:	**Annual (not specified)**	**Projected Total $38,545**
	RT Annual (not specified)	**RT % of Annual Total 47%**
Annual Report Reference:	**# 12, Page 99, R-47**	

OBJECTIVES:

1. To evaluate the immunofluorescence test as a simple clinical method to differentiate localization of upper urinary tract infection from lower urinary tract infection in spinal cord injury patients with neurogenic bladders who have initial or recurrent bacteriuria;
2. To correlate immunofluorescence findings with clinical signs, symptoms, urine cultures, cystograms, intravenous urograms and follow-up renal studies;
3. To determine, when bacteria are positive for immunofluorescence, whether the antibody coating is secondary to renal origin or prostatic origin.

METHODOLOGY: 124 patients with bacteriuria of known origin have had urinary sediment examined by the immunofluorescence technique of Thomas, et al., for the detection of antibody coating. The study population included spinal cord injury victims who are catheter-free but continue to have persistent bacteriuria. Results of the immunofluorescence test are correlated with clinical findings and impressions, urinary cultures, radiologic evidence of urinary tract calculi and the presence of any upper urinary tract involvement as revealed via intravenous pyelogram.

FINDINGS TO DATE: Out of the 124 patients studied, thirty-three patients exhibited upper tract changes on IVP; of these, 26 (79%) exhibited fluorescent bacteria on at least one occasion. Ninety-one patients with bacteriuria demonstrated normal IVP's. Of these, 59 (65%) had bacteria exhibiting fluorescence while 32 (35%) did not.

Urine was also collected from 12 patients who had undergone ureteroileostomies; seven samples contained ACB and five samples did not. Three of the fluorescing samples contained 1+ ACB; one sample had 2+ ACB; two samples had 3+ ACB and final sample had 4+ ACB. Various organism were identified in the urine samples. There was a tendency for a higher proportion of patients with multiple organism to demonstrate ACB than there was among patients with a single infecting organism.

In general, we must conclude that in patients with neurogenic bladders the presence of ACB in the urine is not definitive proof of an upper tract infection nor is the absence of ACB proof that the infection is localized in the bladder.

Persons with urinary ACB are more likely to have upper tract changes than are persons with no urinary ACB. Thirty-one percent of patients with ACB have abnormal IVP's, but this by itself does not seem to test clinically useful.

APPLICABILITY: Urinary tract infection and calculi, which are often interdependent, are among the most frequent complications observed in patients who have sustained spinal cord injury. Although the neurogenic bladder has been studied extensively in the past, renal failure secondary to chronic pyelonephritis is still a major cause of death among these patients. Urinary tract complications account for many of the initial prolonged hospitalizations and frequent readmissions experienced by spinal cord injury victims. Despite progress made through use of intermittent catheterization, chronic bacteriuria and urinary tract complications remain a major health problem. If the source of urinary tract infection could be isolated to the bladder (without evidence of upper tract involvement), the protracted and costly treatment program might be markedly reduced and efforts could then be directed toward treating patients in whom bacteriuria is being produced in the upper urinary tract and among whom gradual renal deterioration can be expected. This procedure could represent a relatively inexpensive clinical laboratory technique that might eventually replace other expensive and time consuming tasks currently being used to localize the source of bacteriuria. If proven to be of value, the immunofluorescence test might also be helpful to many other rehabilitation patients who suffer neurogenic bladder problems.

195 Clinical Assessment of Psychological Adjustment to Spinal Cord Injury

Principal Investigator:	**J. Scott Richards, Ph.D.** **Philip R. Fine, Ph.D.**	
Status:	**Completed**	
Dates:	**April 1975–December 1977**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $32,116** **RT % of Annual Total 57%**
Annual Report Reference:	**# 12, Page 529, R-52**	

OBJECTIVES:

1. To pilot-study a recently developed psychological assessment instrument which attempts (a) to quantitatively measure psychological adaptation and (b) to predict whether a patient is capable of a successful psycho-social adjustment to spinal cord trauma.

METHODOLOGY: A multi-factor psychological assessment instrument measuring ego resilience, internal vs. external locus of control, affective well being and symptoms of stress, patient acceptance of the sick role, future orientation, denial and repression was developed and administered to 69 male and female spinal cord injured patients, ages 14-64. The instrument was administered within one week of the patient's first rehabilitation center admission, within one week of discharge and at one-year post-injury.

Data from the psychological instrument was tabulated and statistically analyzed. In addition, an attempt was made to correlate these psychological variables with an appropriate functional outcome measure at each predetermined interval.

FINDINGS TO DATE: Functional Outcome Measures revealed improved functional ability both from admission to discharge, and from admission to one-year follow-up. Psychological measures, on the other hand, showed greater stability over time, with scores on 11 of 15 scales exhibiting no significant variability.

Multiple linear regression techniques were used to determine whether the independent measures were predictive of the Functional Outcome Measure. Level of lesion consistently accounted for the greatest percentage of variability in Functional Outcome. While the amount of variance in the Functional Outcome data explained by the psychological variables does, in many cases, reach statistical significance, this explained variance was still small. The total variability accounted for by thirteen other predictor variables was often less than that accounted for by level of lesion alone.

The results of this study demonstrate the importance of developing a more empirically-based, objective approach to the assessment of psychological status in which item content will be less obvious in intent, and therefore less subject to patient bias.

APPLICABILITY: Chronic depression, withdrawal, hostility, anger and denial are all features of any catastrophic illness, especially spinal cord injury. The extent to which these psychological characteristics lead to chronic morbidity and failure of vocational adjustment has not been adequately determined. If the psychological instrument is proven to have predictive ability, patients identified as having "poor adjustment prospects" can be provided additional supportive care early in the rehabilitation program. Early intervention may result in improved adaptation to injury for the patient and hopefully reduce future medical and psycho-social complications which may have adverse ramifications. Improving the potential for successful adaptation to physical trauma has broad and far reaching consequences, particularly with reference to eventual vocational rehabilitation.

196 Energy Expenditure While Performing Normal Street Walking—A Comprehensive Study Using MAMA and Involving Paraplegics, Stroke Patients and Amputees, as well as Normal Subjects, and a Variety of Assistive Devices

Principal Investigator:	**Chi-Tsou Huang, M.D.**	
Status:	**Completed**	
Dates:	**January 1975–June 1978**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $216,188** **RT % of Annual Total 69%**
Annual Report Reference:	**# 12, Page 397, R-53**	

OBJECTIVES:

1. To compare energy expenditure during repeated tests of "MAMA-Walking" and treadmill walking.
2. To compare energy expenditure during ambulation by normal subjects, below-the-knee (BK) amputee subjects and above-the-knee (AK) amputee subjects.
3. To compare energy expended by two subjects using different types of lower limb prostheses during ambulation.
4. To compare energy expenditure during ambulation by normal subjects and paraplegics using Craig-Scott braces.
5. To compare energy expenditure requirements of patients (a) during several types of patient transfers and (b) in commonly prescribed hospital bed positions, e.g., Supine, Sitting, Semi-Fowler, etc.
6. To compare energy expenditure of quadriplegics in the sitting position and in the following tilt-table positions: 20° head-down, supine and 30° head-up.

METHODOLOGY: A mobile automatic metabolic analyzer (MAMA) mounted on a motorized cart with an automatic speed control, capable of following a predetermined path is used to measure certain physiologic parameters during activity. Simultaneous measurements of $\%O_2$ $\%CO_2$, $\%N_2$, $\%H_2O$ as well as inspired and expired volumes are acquired. Using gas fractions, volume data and the mathematical technique of indirect calorimetry, true minute oxygen consumption is calculated. All data are reduced to STPD conditions. Energy cost of ambulation calculated from O_2 consumption is then expressed as a function of time, distance or unit weight and body surface area of the subject. All data processing and computation is performed on a PDP 11/40 digital computer.

FINDINGS TO DATE: Previously unsuspected, as well as suspected differences in energy expenditure requirements have been identified in a number of substudies. These results include: (a) Oxygen consumption at subject-specific comfortable walking rates was 9% higher in unilateral BK amputees, 48.7% higher in unilateral AK amputees and 280% higher in bilateral AK amputees when compared with an unimpaired group; (b) statistically significant differences in energy consumption have been observed in subjects using artificial prostheses of varying designs (c) energy expenditure among subjects engaged in common hospitalized patient positions was significantly affected by both position and time within position. The lowest mean energy expenditure was in the semi-fowler # 1-B position, with the highest mean energy expenditure occurring in the semi-fowler # 2-A position. This energy expenditure reflects the move from wheelchair to bed.

APPLICABILITY: Results in findings from these and future studies may be utilized in the selection of prostheses and orthoses as well as in the design of new devices. It is anticipated that a direct clinical application will soon be achieved. Findings from nursing substudies will have direct and immediate clinical application since objective data will be available to direct certain nursing practices regarding patient positioning and transfer modes.

Many conventional braces and prosthetic devices are often prescribed in an arbitrary manner. For this reason large amounts of VRS funding is frequently dissipated into devices which are not commonly used by the client/recipient. MAMA provides a quantitative way to assess the true efficiency related to weight and other mechanical factors of these devices and ultimately will result in tremendous savings when inefficient devices are no longer prescribed.

197 Preliminary Investigation of Micrographic Viewer for Use by Disabled Persons

Principal Investigator:	**James R. Jackson** **Charles R. Healey**	
Status:	**Completed**	
Dates:	**June 1976-December 1977**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $18,402** **RT % of Annual Total 72%**
Annual Report Reference:	**# 12, Page 675, R-60**	

OBJECTIVES:

1. To determine the potential for developing or modifying an inexpensive microfiche viewing system capable of operation by a severely handicapped individual.
2. To determine and document the quantity and nature of commercially available printed material in microfiche format.
3. To determine desirability of development of the micrographic viewer with large fiche capacity.

METHODOLOGY: A comprehensive list of commercial software sources was acquired and a survey letter was sent to all identifiable sources. Results of the survey were compiled and studied. The necessary materials and equipment were acquired and a prototype was constructed. The prototype was evaluated and compared with a series of commercially available page turners for such characteristics as client acceptability, cost, utility, reliability and amount of assistance required for operation.

FINDINGS TO DATE: A micrographic viewer to be used by the severely physically disabled has been designed and constructed. The operational prototype utilizes an inexpensive commercially available microfiche viewer which was the object of several straight-forward modifications. A fan-fold mechanism on both sides of the viewer collects and stores microfiche. The prototype, which is entirely electrically controlled, has a capacity of over 4000 pages of printed information. The cost of replicating the entire system is estimated to be less than $400. As such, this viewer is competitive with currently existing page turners while offering far greater capabilities.

APPLICABILITY: Successful development of a multi-access microfiche viewing device could impact positively on several aspects of the rehabilitation process. It might help create a sense of independence in the user because selection of a variety of reading materials during reading sessions without second party assistance would be possible. In addition, an economical and reliable device of this nature could be used to expand vocational possibilities of severely handicapped persons by allowing access to large quantities of data.

198 Assessment and Evaluation of Home Health Team Activities

Principal Investigator:	**Philip R. Fine, Ph.D.** **Sybil Better, M.A.**	
Status:	**Completed**	
Dates:	**June 1976-May 1978**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $33,300** **RT % of Annual Total 66%**
Annual Report Reference:	**# 12, Page 697, R-61**	

OBJECTIVES:

1. To examine, assess and otherwise evaluate Home Health Team activities including miles traveled, personnel and travel-related costs, number of patients visited, frequency or regularity of visits, etc., since the time of inception and implementation of the Home Health Team to the present.
2. To identify patient problems encountered by providers of home care.
3. To evaluate health status of patients visited by Home Health Team personnel and to compare this status with a matched cohort who has not been visited regularly by Home Health

Team personnel.

4. To identify and otherwise assess the availability of professional and paraprofessional resources in the various counties of Alabama and to compare these numbers with the location of Home Health Team patients' residences.
5. To evaluate, assess and otherwise determine the feasibility of expanding the scope and frequency of services to homebound clients by changing the functional activities of Home Health Team personnel from direct patient care to training of professionals and paraprofessionals who will become responsible for providing patient care in their particular county or geographic subdivision.

METHODOLOGY: A classical administrative/management analysis (detailed fiscal analyses, evaluation of duties, time in field, medical conditions treated, total costs, etc.) was conducted. A statistical analysis of the health status of a sample of spinal cord injury victims who were former patients of this Center and who have been treated with varying frequencies by the Home Health Team was completed. The availability and accessibility of health manpower and resources in the State were examined.

FINDINGS TO DATE: The Home Health Team related cost per spinal cord injury patient on Home Health Team rolls has declined steadily since 1973. The cost per active patient in 1977 was determined to be $150. The cost per visit averaged $144 over the lifetime of the project and has been relatively constant since 1973. Trips to patients' homes averaged 75 miles per visit. A systems analysis of Home Health Team activities suggests a well run and reasonably efficient operation. The data suggest that a team operating under similar conditions (e.g., geographic and demographic) can conduct approximately 300 visits annually, if in the field two days per week, 50 weeks per year.

Architectural barriers were the most common problem identified during predischarge visits to the patient's place of residence. On postdischarge follow-up visits, the two most common problems encountered by the nurse and physical therapist were noncompliance with recommended therapeutic procedures and skin breakdowns, each of which were recorded on the majority of home visit reports. Patients visited frequently by the Home Health Team had more medical and psycho-social problems associated with their disability than did their less frequently visited counterparts.

APPLICABILITY: Findings from this study will assist other rehabilitation centers in determining whether similar activities are economically feasible and cost-effective modalities for providing on-going follow-up care for spinal cord injury patients as well as other severely disabled persons.

199 Linguapalatal Cues as an Aid to Consonant Articulation in Deaf Adults

Principal Investigator:	**Samuel G. Fletcher, Ph.D.**	
Status:	**Completed**	
Dates:	**June 1976-June 1977**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $37,815** **RT % of Annual Total 72%**
Annual Report Reference:	**# 12, Page 817, R-62**	

OBJECTIVES:

1. To instrumentally document linguapalatal contact patterns during utterance of words with sounds such as "t," "s," and "k" that are not normally visible during speech.
2. To provide visual feedback to the speaker, to improve his speech production patterns.

METHODOLOGY: The instrumental device used in the study is the palatometric component of the PAGIS system capable of detecting linguapalatal contacts with electrodes embedded in a thin plastic pseudopalate which adheres to the speaker's hard palate. Acoustic output during speech is monitored with a spectrum analyzer. Data are acquired under on-line control of a PDP 11/40 computer and written on magnetic tape for processing and viewing. A 500 point LED display with appropriate circuitry is utilized to identify tongue to palate contact points. The speaker is notified, visually, of the linguapalatal contact pattern any time one of 96 sensors is touched. The LED display is used as a primary feedback source to assist the speaker in recognition and change of articulation patterns. Proof of advantages achieved by physiologically derived data is obtained by comparison with results from acoustically derived data. A scan converter is used with a currently available 32-channel spectrum analyzer and video monitor. This enables generation of near real time "voice prints" of the subject's speech output.

FINDINGS TO DATE: Speech behavior as reflected in preliminary data has demonstrated a rapid rate of improvement. The "t" sound introduced in a third session was maintained in a variety of nonreinforced contexts during subsequent treatment sessions. Phoneme intelligibility has increased. Articulation of the "t" sound and its voice cognate "d" improved dramatically. (Note: No significant attention was given to the "d" cognate.) Observed improvement appears to demonstrate rapid transfer of the plosive alveolar place of articulation. Less dramatic changes in phonemic intelligibility is shown for the sibilant "s" and its voice cognate "z". Words chosen in the pretest evaluation had a wide variety of sounds substituted for the "s." Word intelligibility also showed improvement. In the pretest 17 (2.4 percent) of 700 possible words were identified correctly while in the post-test 23 (3.3 percent) were also identified. Although not analyzed statistically, this change appears too small to be significant. Preliminary results must be interpreted cautiously. It is unknown how much of the improvement would have been obtained through more traditional approaches. The ease with which the subject perceived differences in sounds and was able to alter the place of articulation was felt to be particularly promising.

APPLICABILITY: The greatest single vocational obstacle faced by deaf speakers is the acquisition of usable articulate speech. The present study has been designed to attack this fundamental problem through use of an instrument system which provides information directly related to articulation of sounds that are not perceptible through lip-reading. Use of this information may be expected to enhance speech production of deaf speakers and thereby markedly improve their prospects for more adequate speech and vocational rehabilitation.

200 Effect of Dantrolene Sodium on the Efflux of Calcium from Isolated Sarcoplasmic Reticulum Vesicles

Principal Investigator:	**Kennon T. Francis, Ph.D.**	
Status:	**Completed**	
Dates:	**June 1977-July 1978**	
Cost:	**Annual (not specified)** **RT Annual (not specified)**	**Projected Total $68,311** **RT % of Annual Total 75%**
Annual Report Reference:	**# 12, Page 237, R-64**	

OBJECTIVES:

1. To examine the calcium sequestering and release parameters of sacroplasmic reticulum from rabbit skeletal and rat cardiac muscle.
2. To examine the effects of dantrolene on the sequestering and release of Ca++ from the sacroplasmic reticulum of rabbit skeletal and rat cardiac muscle.
3. To increase knowledge of basic mechanisms whereby dantrolene effects muscle relaxation.

METHODOLOGY: The sacroplasmic reticulum vesicles will be prepared from rabbit skeletal muscle by the method of Fairhurst. The vesicles will be partially loaded with calcium oxalate by incubating for 7 minutes at 30°C with 3 ml of uptake medium containing ^{45}CA labelled CaCl$_2$, ATP, EGTA, KCl, MgCl$_2$, potassium oxalate, and imidazole at pH 7. Then, 97 ml of efflux medium will be added. Various drugs and/or calcium will be added to the efflux medium to test their effect on efflux of ^{45}Ca. Samples will be removed at 1, 5, 10, and 15 minutes after addition of the efflux medium, rapidly filtered, and aliquots counted in a liquid scintillation counter. Protein will be determined by the method of Lowry et al. Based on these initial studies, the efflux media will be modified to obtain the optimum ratio of calcium, rat cardiac sacroplasmic reticulum vesicles. Data will be analyzed using Lineweaver-Burk plots.

FINDINGS TO DATE: Analysis of preliminary data indicates that a 15 minute exposure of sacroplasmic reticulum vesicles alters the rate of ^{45}Ca efflux as well as the amount of calcium retained. The inhibition of calcium efflux appears to be calcium sensitive. The effect of dantrolene on the inhibition of calcium efflux appears to be directly related to dantrolene concentrations above 3×10^{-5}M. It is evident that dantrolene acts at a site on the sacroplasmic reticulum which suppresses but does not completely inhibit the release of calcium.

APPLICABILITY: The problems of spasticity and abnormal motor performance present a major challenge to those involved in rehabilitation. Since spasticity appears to impede motor recovery and performance, an agent which relieves spasticity might be expected to improve motor performance. Dantrolene sodium has been found to be beneficial in the treatment of spasticity in many patients. This study should provide further evidence regarding the efficacy and mechanism of action of dantrolene. The data will be useful in planning drug regimes for controlling spasticity, maintaining beneficial changes and interpreting side effects.

201 The Effect of Disodium Etidronate on the Recurrence of Ectopic Calcification Following Surgical Removal

Principal Investigator:	**Samuel L. Stover, M.D.**	
Status:	**Continuing**	
Dates:	**October 1970-June 1980**	
Cost:	**Annual $13,618** **RT Annual $11,618**	**Projected Total (not specified)** **RT % of Annual Total 85%**
Annual Report Reference:	**# 12, Page 49, R-13**	

OBJECTIVES:

1. To demonstrate the effectiveness of disodium etidronate in preventing postoperative recurrence of heterotopic ossification (HO) in patients with spinal cord injury, ankylosing spondylosis and other severe neurological conditions in which surgical excision of the heterotopic bone is indicated.
2. To demonstrate that the prevention of postoperative recurrence allows greater joint range of motion and improves function.

METHODOLOGY: This long-term study has utilized three protocols. The patient population was restricted to persons 16 years of age or older who suffered spinal cord injuries or who, because of other severe neurological injuries or illnesses, developed HO requiring surgical intervention. The experimental drug, EHDP, is administered both pre- and postoperatively for varying periods of time. In the first protocol completed in 1974 the patient served as his/her own control. Subsequent protocols were double-blind studies distinguishable by the length of postoperative administration of drug and dosage following surgery. Patients are followed closely correlating laboratory studies, clinical course, joint range of motion and x-ray findings to evaluate the efficacy of the drug.

FINDINGS TO DATE: Examination of current data acquired on patients who received placebo in the double-blind study, as well as the data acquired from those who received the drug in the double-blind study and drug in the controlled study reveals rather definitive information.

Four spinal cord injury patients had a total of 7 wedge-resections for HO in 5 hips. 2 patients served as their own control. 2 patients were on the double-blind study; 1 receiving EHDP and one placebo. A comparison of postoperative results following 3 wedge resections among untreated or placebo patients to results from patients treated with EHDP demonstrated the efficacy of the drug in prevention of postoperative recurrence. This is evidenced by the fact that HO was demonstrated on x-ray less than 3 weeks postoperatively in all 3 non-treated and placebo patients, progressing to recurrent ankylosis despite efforts to maintain range of motion.

During the past year 2 additional patients entered the series and a total of 4 operative procedures for the removal of HO have been performed. The study population now consists of 16 patients who have undergone a total of 26 procedures. Further breakdown of procedures reveals removal of heterotopic bone occurring about the hip in 15 patients (25 procedures) and removal of heterotopic bone occurring about the elbow in 1 patient (1 procedure). Among those patients receiving placebo, 6 patients underwent a total of 9 procedures. Varying degrees of heterotopic ossification recurred after all surgical procedures with recurrence evident within three weeks of surgery. 4 of 5 patients receiving drugs who had undergone a total of 5 surgical procedures experienced no recurrence.

EHDP is the first therapeutic agent with definitive effectiveness in delaying and partially preventing recurrent postoperative HO. In the 3 protocols utilized in this study, the length of time of EHDP treatment is variable. After drug withdrawal the extent of HO recurrence appears to be inversely proportional to the size of the initial bone mass and the length of treatment. Maturity of HO does not seem to influence the effect of EHDP but may influence the recurrence after drug withdrawal. Longer treatment periods may further decrease the extent of recurrence allowing patients to achieve and maintain improved joint mobility and function.

APPLICABILITY: HO is a common complication of spinal cord injury necessitating absenteeism and surgical removal when sufficiently severe to inhibit range of motion of the joints, particularly the hips, to make the patient functionally as independent as possible and prevent the usual recurrence of ectopic bone.

This drug shows considerable promise in preventing recurrence of ectopic bone (HO) formation after surgical excision.

202 Overcoming Disincentives to the Rehabilitation of SSI and SSDI

Principal Investigator:	**Sybil Better, M.A.; Philip R. Fine, Ph.D.** **Gordon H. Doss, M.A.**	
Status:	**Continuing**	
Dates:	**June 1976-June 1979**	
Cost:	**Annual $49,627** **RT Annual $49,627**	**Projected Total $150,000** **RT % of Annual Total 100%**
Annual Report Reference:	**# 12, Page 571, R-55**	

OBJECTIVES:

1. To identify, define, examine and document the universe of apparent and obscure disincentives which may be operating among social security beneficiaries as deterrents to the vocational rehabilitation process;
2. To construct a retrospective profile of SSI/SSDI beneficiaries who successfully complete or do not complete a vocational rehabilitation program;
3. To examine the interactive role of apparent, obscure and documented disincentives in the eventual outcome and vocational rehabilitation process among SSI/SSDI beneficiaries;
4. To determine the feasibility of constructing a model capable of simulating vocational rehabilitation outcome responses for selected disincentives;
5. To develop experimental intervention strategies intended to enhance probability of successful completion of a vocational rehabilitation program;
6. To provide descriptive statements supported by objective data which address numerous questions about SSI/SSDI beneficiaries involved in vocational rehabilitation programs who may confront or may be confronted by universal apparent and/or obscure disincentives, each subject to the influence of unique personal characteristics.

METHODOLOGY: Data on disincentives to vocational rehabilitation will be collected in a two-phase project. During phase I, RSA 300 data from a national sample (n = 65,155) were analyzed to obtain descriptive profiles of demographic and other characteristics which distinguish between

SSI and/or SSDI beneficiaries who completed, as opposed to those who did not complete, a vocational rehabilitation program. During Phase II of the project successfully and unsuccessfully rehabilitated clients and rehabilitation counselors will be questioned, utilizing a structured interview schedule, about their perceptions of disincentives to vocational rehabilitation. Analyses of the data in conjunction with demographic and other biographic information on both groups of respondents will submit the examination of intergroup differences in processions of deterrents to vocational rehabilitation.

FINDINGS TO DATE: Vocational Rehabilitation Clients receiving Social Security Disability Insurance and Supplemental Security Income are rehabilitated at a lower rate than non-beneficiaries or severely disabled clients in general. Furthermore, rehabilitated beneficiaries are underrepresented among clients who were self-employed or working in the competitive labor market at the time of case closure; instead, beneficiaries are disproportionately employed in sheltered settings and in the home (i.e. homemakers, unpaid family workers). These findings suggest that severity of disability accounts, at least in part, for problems in rehabilitating beneficiaries. However, it also appears reasonable to conclude that disability-related benefits discourage some disabled individuals from returning to the labor force.

Profiles of rehabilitated and nonrehabilitated clients were developed for the total client sample as well as the beneficiary subset. Only three Entry variables were found to distinguish between clients of differing rehabilitation outcomes in both samples: (1) major disabling condition, (2) work status at entry into the program, and (3) source of referral to VR. Status 26 closures were more frequent among clients whose major disabilities were visual or hearing impairments, amputations, digestive disorders and genito-urinary conditions (excluding End-Stage-Renal Disease). Similarly, clients reporting any vocational or vocationally related activity (i.e. labor force participant, homemaker, unpaid family worker or student) at program entry were disproportionately likely to be rehabilitated. In addition, referrals by educational institutions, private organizations, and self-referrals resulted in above average rates of rehabilitation. Rehabilitation process variables (time in rehabilitation, types and costs of services provided) were generally poor predictors of closure status, the exceptions being: (1) number of services received by clients, and (2) agency provision of restoration services and adjustment training.

For both the Total and Beneficiary Samples, a majority of nonrehabilitated closures were attributed to breakdowns in agency-client relationships. However, while an inability to contact a client was the predominant reason cited in case closures in the total client sample, severity of handicap was the major factor accounting for nonrehabilitated outcomes among beneficiaries.

The results of a comparison of Vocational Rehabilitation clients who are recipients of SSI and SSDI benefits with their non-beneficiary counterparts are also presented. A brief review of these results reveals that at entry into the program, beneficiaries differed from non-beneficiaries on a large number of variables including age, family size, major disabling condition, work status, and source of referral to VR. However, their rehabilitation programs were quite similar in terms of expenditures, months in various statuses and services provided. Nevertheless, and as previously noted, the probability of being rehabilitated was lower for beneficiaries.

APPLICABILITY: The Vocational Rehabilitation Act of 1973 establishes a primary goal of the State/Federal Rehabilitation Program as the "return of disabled persons, when possible, to substantial gainful activity." It is known many severely disabled persons often find it necessary to apply for and receive SSDI and/or SSI benefits during the course of rehabilitation. Under present Social Security law, a recipient who subsequently becomes rehabilitated and ready for employment finds himself in the rather awkward situation of being unable to afford to return to work. Knowledge of the characteristics of clients who are not rehabilitated and disincentives to their rehabilitation is necessary if modification to delivery of rehabilitation services and the mellieu in which they are provided is to be successful.

203 Renal Scintillation Camera Studies as a Method of Following Renal Function and Urological Management in Spinal Cord Injury Patients with Neurogenic Bladder

Principal Investigator:	**Samuel L. Stover, M.D.**
Status:	**Continuing**
Dates:	**June 1976–May 1981**

Cost:	**Annual $61,505** **RT Annual $49,305**	**Projected Total $615,063** **RT % of Annual Total 80%**
Annual Report Reference:	**# 12, Page 125, R-56**	

OBJECTIVES:

1. To compare results of the comprehensive renal scintigraphy procedure (CRSP) and plain film KUB x-rays with the excretory urogram in a series of SCI patients with neurogenic bladder to identify changes in renal function detected by the scintigraphic technique and to correlate these changes with visible anatomic and/or gross functional changes revealed by plain film KUB x-rays and excretory urograms;
2. To compare post-void residual urine volumes measured by renal scintigraphy to volumes obtained by catheterization;
3. To compare results of renal function measured using the CRSP to laboratory measurements of serum urea nitrogen and serum creatinine;
4. To compare abnormalities identified on cystourethrography to functional results obtained using the CRSP and plain film KUB x-rays;
5. To develop and test a predictive model for future urinary tract complications using past and present values of results from the CRSP, excretory urogram, cystourethrogram, plain film KUB x-ray and blood chemistry procedures;

METHODOLOGY: Morphological and functional assessment of the genitourinary system will be performed in a series of spinal cord injury patients with accompanying neurogenic bladder using two diagnostic routines: (1) CRSP and plain film x-rays of the kidneys, ureters and bladder; and (2) excretory urograms, residual urine volume measurements, serum urea nitrogen and serum creatinine determinations and cystourethrograms during the initial hospitalization and/or at regularly scheduled follow-up evaluations. Test results from the two diagnostic routines will be examined to determine the comparability of data derived from various procedures. Regression equations, correlation coefficients and other statistical expressions will be calculated to determine the sensitivity and specificity of each measure.

FINDINGS TO DATE: Preliminary results are available for 71 patients with CRSP's and excretory urograms (EXU's). Comparison of the results of both procedures for these patients revealed the following: (1) six had normal EXU's and CRSP's; (2) forty-one had abnormal CRSP studies and EXU's; (3) four had an abnormal EXU but a normal CRSP study; and (4) twenty had normal EXU's but abnormal CRSP's. The EXU's and CRSP studies with abnormalities or discrepanices are currently being compared.

APPLICABILITY: The spinal cord injured patient with neurogenic bladder often has multiple urological complications which may progress to renal failure and death. Of death occurring in spinal cord injury patients, approximately 50% are renal deaths. Urological problems often prolong the disability, require protracted or repeated hospitalization, and may preclude some of these severely disabled patients from returning to vocational pursuits. Improved and less complicated methods for evaluating renal function in these patients should facilitate urologic management, decrease costs of associated hospitalization and allow more continuity of vocational activities as well as prolong the life of the patient.

204 Long-Term Follow-Up Studies of Patients with Spinal Cord Injury Who Became Catheter-Free Following an Intermittent Catheterization Program

Principal Investigator:	**Samuel L. Stover, M.D.**	
Status:	**Continuing**	
Dates:	**June 1976-June 1979**	
Cost:	**Annual $19,429** **RT Annual $14,804**	**Projected Total $58,287** **RT % of Annual Total 76%**
Annual Report Reference:	**# 12, Page 177, R-57**	

OBJECTIVES:

1. To evaluate long-term renal status and complications among patients who have successfully

completed the intermittent catheterization program (ICP).

2. To compare long-term renal status and medical complication findings on catheter-free patients with similar findings from those of patients who never become catheter-free and continue with an indwelling catheter.
3. To evaluate chronic bladder changes on follow-up examination and effects of such changes on upper urinary tract deterioration.
4. To re-evaluate previous literature which suggests ICP followed by a catheter-free state is the ideal method of long-term urinary tract drainage.

METHODOLOGY: An ICP has been in progress for 6 years. All male spinal cord injury patients enter the program unless entry is precluded by specific contraindication. All patients are followed on a long-term basis and studied for morphologic and functional changes in kidneys, ureters and bladder. The protocol utilized pyelocaliectasis as the determinant of upper tract (renal) abnormality. Caliectasis must be present to be considered abnormal. Dilitation of the renal pelvis or ureter without caliectasis is not reported as abnormal. Degrees of pyelocaliectasis are graded according to predetermined parameters.

FINDINGS TO DATE: 152 male SCI patients whose acute bladder management included indwelling urethral catheters have been converted to an ICP with most achieving a catheter-free state. Twenty-seven percent of these patients were observed to have some degree of pyelocaliectasis on the most recent excretory urogram. Patients with incomplete injuries were found to have a somewhat greater risk of developing pyelocaliectasis. Right side predominance of pyelocaliectasis was also demonstrated. Preliminary findings support the contention that intensive urological follow-up is necessary for all spinal cord injury patients even though a catheter-free state has been achieved through use of intermittent catheterization.

APPLICABILITY: Since introduction of the ICP at this Center six years ago, a large amount of data has been collected on patients who enter the program. These data are being analyzed to evaluate long-term effects of catheter removal. Long-term follow-up evaluation is necessary to prove or disprove the efficacy of the catheter-free state as the method of choice of bladder drainage in patients with neurogenic bladders secondary to spinal cord injury.

205 Pain in Spinal Cord Injury

Principal Investigator:	**Cecil S. Nepomuceno, M.D.**	
Status:	**Continuing**	
Dates:	**June 1976-September 1978**	
Cost:	**Annual $15,497** **RT Annual $14,556**	**Projected Total $32,000** **RT % of Annual Total 93%**
Annual Report Reference:	**# 12, Page 197, R-58**	

OBJECTIVES:

1. To characterize pain as it occurs and is described by a series of spinal cord injury patients.
2. To analyze and evaluate these characterizations in terms of psychological, physical and demographic variables on a patient specific and series basis.

METHODOLOGY: Spinal cord injury patients with lesions of at least 12 months duration were asked to respond to a series of questions about their condition and any associated discomfort/pain Criteria for inclusion in the study do not include level or extent of lesion or nature of associated injuries, although these variables will be subject to consideration when data are ultimately analyzed.

FINDINGS TO DATE: 200 of 356 questionnaires (56%) were completed and categorized into 4 groups by level of lesion. 160 subjects (80%) reported having experienced pain they believe to be associated with the spinal cord injury. These patients were asked to describe the nature of the pain utilizing a wide variety of objective and subjective descriptors.

The reported incidence of pain was higher among patients whose lesions were at the neurologic level of T7 or below. Pain occurred within 6 months of injury for 65% of those patients who reported pain. Patients with cervical cord injuries most often experienced upper extremity pain; trunk pain was more common among patients with upper thoracic injuries; lower extremity pain was most often experienced by patinets with lower thoracic and cauda equina lesions. 64 patients reported their pain interfered with daily living activities. 32 patients indicated their pain grew more severe with time, while only 12 patients indicated a diminution of pain. Patients with low level lesions were more willing to "trade-off" any possibility of recovery and/or loss of regained physiologic function for pain relief than were patients whose lesions were at a higher neurologic level.

APPLICABILITY: Information gathered from this study can be immediately utilized by clinicians, therapists, psychologists and vocational counselors in spinal cord injury rehabilitation programs. These data may prove useful to the professional rehabilitation specialist in assessing, evaluating and accurately determining the impact and role of pain as it influences or affects the rehabilitation process. The findings may lend insight into the physical and psycho-dynamic aspects of the phenomenon as it occurs in spinal cord injury and may assist rehabilitation specialists in creating realistic goals for the patient/client.

206 Bowel Regulation in Spinal Cord Injury

Principal Investigator: **Cecil S. Nepomuceno, M.D.**
Status: **Continuing**
Dates: **June 1977-June 1980**
Cost: **Annual $6,928** **Projected Total $20,748**
RT Annual $6,928 **RT % of Annual Total 100%**
Annual Report Reference: **# 12, Page 223, R-63**

OBJECTIVES:

1. To determine the medical appropriateness and patient acceptability of a bowel training program for spinal cord injury patients utilized by this Rehabilitation Center.
2. To document individual modifications of the established program instituted by the spinal cord injury patient following hospital discharge.
3. To identify bowel program modifications initiated by the successfully rehabilitated spinal cord injury patient which might be integrated into the established program utilized by this Rehabilitation Center.

METHODOLOGY: Forty spinal cord injury patients with complete lesions will participate in a bowel training program while hospitalized at the Rehabilitation Center. At patient discharge, measures of medical appropriateness and patient satisfaction will be collected. The patient's bowel program status will be reassessed upon return to follow-up medical examinations for a period of five years. Individual modifications of the established program instituted by the patient following discharge will be documented.

FINDINGS TO DATE: As of November, 1977, eight spinal cord injury patients who agreed to participate in the project have been discharged from the Rehabilitation Center. Since these are recent discharges, none have returned for an annual follow-up visit. Analysis of findings has not been pursued at this time.

APPLICABILITY: Bowel training is an important component of any comprehensive rehabilitation program for spinal cord injury patients. The bowel training program must be satisfactory to the physician and acceptable to the patient as well. If a successful bowel training program can be instituted early in the rehabilitation process, the patient's long-term potential for vocational rehabilitation may be enhanced.

207 Electromyographic Findings in Spastic and in Flaccid Spinal Cord Injury

Principal Investigator:	**Cecil S. Nepomuceno, M.D.**	
Status:	**Continuing**	
Dates:	**June 1977-June 1980**	
Cost:	**Annual $12,915**	**Projected Total $40,245**
	RT Annual $10,952	**RT % of Annual Total 85%**
Annual Report Reference:	**# 12, Page 253, R-65**	

OBJECTIVES: To demonstrate positive sharp waves and fibrillation potentials resulting from UMN lesions and to distinguish them from similar electrical activity observed in LMN lesions. Demonstration of spontaneous activity will be achieved by use of electromyography. Differentiation will be attempted utilizing previously developed computer-assisted analysis procedures.

METHODOLOGY: 50 spinal cord injury patients with neurologically complete lesions at the level of T10 or above will constitute the study population. These patients will be divided equally into two groups on the basis of flaccidity or spasticity of the lower extremities. A TECA, Model 4, Electromyograph will be used. The proximal, middle and distal areas of both quadriceps, as well as the medial and lateral hamstrings will be examined. Positive sharp waves and/or fibrillation potentials will be recorded on magnetic tapes and light sensitive paper and graded. The magnetic tapes will be analyzed by computer to extract parameters from positive sharp waves and fibrillation potential located by the program. For the positive sharp waves, an oscilloscope will be used to identify the locations of segments containing data of interest. These will include well-defined sequences of positive sharp waves in which individual wave packets can be identified. Parameters for each wave packet will be determined and subjected to an analysis of variance to yield differences between lesions.

FINDINGS TO DATE: As of November 28, 1977, 9 patients with spastic lower extremities and 4 with flaccid lower extremities were found to be suitable for inclusion in the study. Patients will continue to be identified and tested until the projected number of subjects, in each category, has been achieved. Data will be analyzed, at one time, near the end of the project period.

APPLICABILITY: The information and findings gathered in this study can be immediately utilized by medical and paramedical personnel managing spinal cord injured patients. The procedures applied here can disclose the pathological state of the spinal cord segment below the level of injury, specifically the integrity of the spinal center for bowel, bladder and sexual regulation.

208 Frequency and Volume of Urination in Patients with Spinal Cord Injuries

Principal Investigator:	**L. Keith Lloyd, M.D.** **Keith V. Kuhlemeier, Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1977-June 1979**	
Cost:	**Annual $15,088**	**Projected Total $35,036**
	RT Annual $13,200	**RT % of Annual Total 88%**
Annual Report Reference:	**# 12, Page 269, R-66**	

OBJECTIVES:

1. To determine the capabilities of a newly developed uroflowmeter, and the ease with which it can be applied to clinical situations.
2. To determine the pattern of voiding events in patients with neurogenic bladder secondary to spinal cord injury.

METHODOLOGY: A uroflowmeter was devised which records time and volume of micturition. The study population will be divided into three groups: (1) patients with recent spinal cord injuries who are admitted for initial evaluation and therapy, (2) patients who are readmitted for follow-up examination or for treatment of specific problems, and (3) patients who are rehospitalized for external sphincterotomy. All patients will undergo a cystometrogram with simultaneous electromyography of the external sphincter as well as urethral pressure profiles. Intravenous pyelograms (IVP) and the results of the most recent examination will be evaluated for all patients. However, excretory urograms and cystograms will not be a specific prerequisite for admission into the study population.

FINDINGS TO DATE: During the first two months of the study, seven patients were placed in the first group and two were placed in the third group. The mean void volume for the seven group 1 patients was 65 mls/void and ranged from 28 mls/void to 127 mls/void. The mean time interval between voids was 58 minutes and ranged from 30 minutes to 185 minutes. Intervoid time intervals decreased dramatically for the two patients in group 3 following sphincterotomy. These finds will be updated as more patients enter the study population.

APPLICABILITY: If the clinical usefulness of the uroflowmeter is verified, it can be used by urologists and physiatrists in various settings. If the uroflowmeter increases the accuracy of diagnosis or if it can replace more expensive diagnostic procedures, it could assume a role in standardized urological examinations and patient management practices.

209 Mechanisms of Pyelonephritis in Spinal Cord Injured Patients

Principal Investigator:	**George Hemstreet, M.D., Ph.D.**	
Status:	**Continuing**	
Dates:	**June 1977-June 1982**	
Cost:	**Annual $60,537** **RT Annual $54,608**	**Projected Total $431,585** **RT % of Annual Total 90%**
Annual Report Reference:	**# 12, Page 281, R-67**	

OBJECTIVES: To investigate the mechanisms involved in kidney tubule cell destruction in chronic pyelonephritis.

METHODOLOGY: In the first phase of this project kidney tubule cells from rate and human kidneys will be cultured. The cells will then be radiolabeled with Cr^{51} radioisotopes. The second phase focuses on the development of the Cr^{51} microcytotoxicity assay and the growth of gram negative E. coli bacteria and the preparation of lipopolysaccharides. In the final phase, various cytotoxic mechanisms will be investigated that may be involved in kidney tubule cell destruction. These mechanisms include measurement of direct cell mediated cytotoxicity and antibody dependent cellularcytotoxicity. Target cells include normal cultured kidney cells, normal cultured kidney cells treated with lipopolysaccharides, and normal cultured kidney cells incubated with bacterial exotoxins.

FINDINGS TO DATE: Short-term cultures of rat kidney and human kidney tubule cells have been obtained. These tubule cells have been successfully labelled with CR^{51} and control assay systems established for detecting antibody-dependent cytotoxicity. Rats immunized with purified lipopolysaccharide from Salmonella Re 595 demonstrate pathologic changes consistent with those seen in pyelonephritis. Scoring techniques for evaluating these kidneys have been established. In addition, sera from immunized animals has been shown to have cytotoxicity against syngeneic cells in tissue culture. Other mechanisms of kidney cell death are currently being investigated.

APPLICABILITY: A more precise understanding of immunologic mechanisms associated with pyelonephritis will be useful in developing more appropriate techniques for the management of urinary tract infection and recurrent pyelonephritis. Understanding host-defense mechanisms may be important in prevention of acute and chronic pyelonephritis.

210 The Effect of Dantrolene Sodium with the Mixed Function Oxidase System of Rat Liver

Principal Investigator: **Kennon T. Francis, Ph.D.**
Status: **New**
Dates: **July 1978-June 1980**
Cost: **Annual $20,818** **Projected Total $46,160**
RT Annual $19,962 **RT % of Annual Total 96%**
Annual Report Reference: **# 12, Page 321, R-68 (P-8)**

OBJECTIVES:

1. To study the metabolism of hexobarbital in male and female rats pretreated with acute doses of dantrolene.
2. To study the metabolism of ethylmorphine and determine the amount of cytochrome P-450 and NADPH reductase in rats pretreated with acute doses of dantrolene.
3. To study the ability of the mixed function oxidase system to be induced by phenobarbital with the simultaneous administration of dantrolene.
4. To study the dose effect relationship of dantrolene on the metabolism of ethylmorphine.
5. To study the recovery of the mixed function oxidase system after pretreatment with dantrolene.
6. To study the effect of dantrolene on the adrenal cortex and glucocorticoids.

METHODOLOGY: Rats will be pretreated with varying dosages of dantrolene. Hexobarbital, phenobarbital or cortisone will also be administered to some animals.

Drug administration will be followed by measurement of sleeping periods, ability to metabolize ethylmorphine, amounts of cytochrome P-450, NADPH reductase activity and cortisol, and/or adrenal gland weight.

FINDINGS TO DATE: Since this is a new project, data analysis has not yet been initiated.

APPLICABILITY: Dantrolene sodium became commercially available in 1974 and has been used to decrease skeletal muscle spasticity in patients with various disorders. However, hepatotoxicity is one reported adverse effect of this drug which should be considered in further detail. Clarification of the site of drug action in the liver is necessary so possible precautions may be taken by physicians prescribing the drug.

211 Development and Evaluation of a Communications, Control, Education and Entertainment System (C2E2) for the Severely Disabled Based on Commercially Available Microcomputer Systems

Principal Investigator: **Charles R. Healey**
Status: **New**
Dates: **October 1978-March 1981**
Cost: **Annual $32,018** **Projected Total $83,000**
RT Annual $32,018 **RT % of Annual Total 100%**
Annual Report Reference: **# 12, Page 381, R-69 (P-G)**

OBJECTIVES:

1. To develop and demonstrate the usefulness and economic feasibility of microcomputer system applications for purposes of communication, environmental control, computer aided instruction (CAI) and entertainment for persons with severely disabling conditions.
2. To disseminate system information and otherwise promote, encourage and stimulate further applications and expanded utility via the development of additional software and hardware.
3. To solicit, evaluate and disseminate software and hardware designs created expressly for use by the severely physically disabled.

METHODOLOGY: A model multi-purpose microcomputer system for use by the severely disabled will be designed and constructed using commercially available and custom-made system components. Appropriate software will also be developed, implemented and refined. Project-related system information will be disseminated to the rehabilitation community, microcomputer enthusiasts, potential user groups, etc.

FINDINGS TO DATE: Work has not yet been initiated on this project.

APPLICABILITY: Successful development of a microcomputer system for use by the severely physically disabled, coupled with the involvement of computer hobbyists in the development of future hardware and software improvements, will allow patients to address many physical needs and perform numerous activities of daily living with minimal assistance from family members or attendants.

Utilization of units for environmental control, communication, entertainment and education also will meet numerous psychological as well as physical needs of the severely physically disabled.

212 The Effect of Abdominal and Lower Limb Compression on Cardiopulmonary Response and Energy Cost in High Spinal Cord Injury Patients

Principal Investigator:	**C. T. Huang, M.D.**	
Status:	**New**	
Dates:	**June 1978-June 1980**	
Cost:	**Annual $55,308** **RT Annual $55,308**	**Projected Total $105,000 ± 8%** **RT % Annual Total 100%**
Annual Report Reference:	**# 12, Page 475, R-70**	

OBJECTIVES:

1. To determine the value of pneumatic compressive devices in preventing the occurrence of orthostatic hypotension among patients having recent injuries to the cervical spinal cord.

METHODOLOGY: Using the Mobile Automatic Metabolic Analyzer (M.A.M.A.), data will be collected on metabolic responses of spinal cord injury patients during movement to and maintenance of six predefined postural changes while wearing an inflatable abdominal corset or bilateral pneumatic leg splints. Cardiopulmonary responses will also be monitored.

FINDINGS TO DATE: This project has only recently been initiated and no findings are available at present.

APPLICABILITY: It is desirable that tolerance to postural change be achieved during the early physical rehabilitation of patients having lesions of the cervical spinal cord so they may participate in tilt-table treatments. Moreover, quadriplegics cannot begin adapting to wheelchair confinement until able to tolerate an upright position. If artificial abdominal support and/or lower limb constriction with an easily achievable effective pressure range can be shown to prevent cardiopulmonary distress and/or reduce energy costs associated with achieving and maintaining an upright posture among quadriplegics, their initial rehabilitation will be facilitated.

213 Energy Expenditure, Heart Rate, Rhythm and Blood Pressure in Normal and C.O.P.D. Subjects Engaged in Common Hospitalized Patient Positions and Modes of Patient Transfer

Principal Investigator:	**Lillian Ericksen, R.N., M.Sc.N.,** **Doctoral Candidate**	
Status:	**New**	
Dates:	**June 1978-January 1980**	
Cost:	**Annual $28,527** **RT Annual $18,527**	**Projected Total $51,289** **RT % of Annual Total 65%**
Annual Report Reference:	**# 12, Page 499, R-71 (P-I)**	

OBJECTIVES:

1. To compare energy expenditures of normal subjects and subjects with chronic obstructive pulmonary disease (C.O.P.D.) in five positions and modes of transfer common to hospitalized patients.
2. To examine the relationships between energy expenditure, heart rate and rhythm and systolic and diastolic blood pressures among normal and C.O.P.D. subjects.

METHODOLOGY: The Mobile Automatic Metabolic Analyzer (M.A.M.A.) will be used to measure energy expenditure by normal and C.O.P.D. subjects in five positions and modes of transfer. Heart rate and rhythm and systolic and diastolic blood pressure of subjects will also be monitored.

FINDINGS TO DATE: Because this project has only recently been initiated, no findings are currently available.

APPLICABILITY: A major problem of persons suffering chronic obstructive pulmonary disease (C.O.P.D.) is management of scarce energy. If the amount of energy required to assume various bed positions and carry-out specified transfer modes can be quantified, nursing personnel will have clinical data upon which to select the most appropriate and energy efficient positions and modes of transfer for the patient with chronic obstructive pulmonary disease. Thus, energy saved can be used by the patient to satisfy other energy demands such as his vocation and activities of daily living.

214 The Effects of Spinal Cord Injury on Helpless Behavior: A 'Real World' Application of Seligman's Learned Helplessness Theory

Principal Investigator:	**Rosemary Wool, M.A.** **J. Scott Richards, Ph.D.**	
Status:	**New**	
Dates:	**June 1978-June 1980**	
Cost:	**Annual $30,504**	**Projected Total $63,500**
	RT Annual $14,504	**RT % of Annual Total 48%**
Annual Report Reference:	**# 12, Page 773, R-72 (P-K)**	

OBJECTIVES:

1. To adapt traditional learned helplessness assessment tasks (verbal and motor) for use with spinal cord injured patients.
2. To utilize modified learned helplessness tasks to determine whether personality and coping styles (e.g. passivity, dependency, depression, etc.) of the spinal cord injured differ from those demonstrated by non-injured subjects.

METHODOLOGY: During a pretreatment phase, subjects will be presented with solvable or unsolvable verbal and motor tasks to perform. In a subsequent test phase, subject response to solvable motor and verbal tasks will be measured.

FINDINGS TO DATE: Analysis of data will not commence until completion of data collection.

APPLICABILITY: In this project, the existence of distinct personality and coping styles differentiating spinal cord injured patients from non-paralyzed individuals will be studied. The learned helplessness paradigm, a relatively new behavior measure of personality traits developed by Seligman, is the method to be used.

This project will contribute to the literature addressing the psychological aspects of spinal cord injury and help rehabilitation workers plan and provide appropriate services for these patients.

Northwestern University (RT-20)
Medical Rehabilitation Research and Training Center

CORE AREAS

Neuromuscular Studies Unit

To improve clinical management of neuromuscular dysfunction through development of advanced techniques in diagnosis and understanding of cause and control of neuro motor disturbance.

Rehabilitation Services Evaluation Unit

Improving Management and delivery of rehabilitation services through evaluative feedback of programs, procedures and devices constituting the rehabilitative process.

Spinal Cord Injury Rehabilitation Studies

To develop new knowledge in the prevention of medical complications, the maximization of physical and psychologic function, resocialization and vocational achievement of the spinal cord injured.

Behavioral Studies Unit

To improve human performance of the physically disabled through new understanding of the behavior of the disabled individual, significant others and the providers of rehabilitative assistance.

NORTHWESTERN UNIVERSITY

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PROJECT TITLES BY 1978 STATUS

COMPLETED

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215 Histochemical and Ultrastructural Study of Human Muscle Spindles: Spasticity

Principal Investigator:	**V. Sahgal, M.D.**	
Status:	**Completed**	
Dates:	**April 1976-March 1978**	
Cost:	**Annual $19,221** **RT Annual $10,743**	**Projected Total $62,167** **RT % of Annual Total 56%**
Annual Report Reference:	**#10 Page 30, R-22A**	

OBJECTIVES: To study the morphological (including ultrastructure) and histochemical changes in human muscle spindle in spasticity.

METHODOLOGY: Techniques previously described in proposal R-22A (1975) and our publications (Sahgal, et.al., 1973; Sahgal, et.al., 1976) were used.

FINDINGS TO DATE: More than 30 muscle spindles of human spastic quadriceps muscles (two months to two years duration) have been examined histochemically and ultrasonically. The findings indicate that the muscle spindle in the spastic limbs shows increased numbers of intrafusal fibers with marked variation in fiber size. The very small fibers demonstrated histochemical characteristics of the nuclear bag fibers; that is, two types of ATPase reaction, peripheral nuclei and increased sub-sarcolemal oxidative enzyme activity. The increased number of intrafusal fibers can be explained on the basis of splitting of the nuclear bag fibers. This splitting is perhaps the result of mechanical stretcn exerted on the muscle because of continuous spasticity and periodic extensor spasms. Mechanical hypothesis of stretching as a cause of fiber splitting in intra and extrafusal fibers has been proposed to explain similar findings in myotonic and other dystrophies.

The close resemblance of the small fibers to the nuclear bag fibers suggests selective splitting of the nuclear bag fibers with preservation of nuclear chain fibers. The significance of this finding and the physiological correlation are not clear.

APPLICABILITY: The practical use of this work has been and will be twofold:

Clinical practice. The development and application of these procedures (quantitative histochemistry and structure of human biopsy muscle) is significantly improving the accuracy of muscle disease diagnosis.

Clinical research. These procedures and the new information they are beginning to produce apply directly to the clinical research problem of understanding what is "wrong" with muscle and its nerve control in such rehabilitation-relevant problems as spasticity. It is from this information that a rational means of preventing, curing or controlling spasticity can be achieved.

216 Electromyographic and Cystometrographic Study of Human Bladder

Principal Investigator:	**P. Kaplan, M.D.**	
Status:	**Completed**	
Dates:	**March 1975-March 1977**	
Cost:	**Annual $** **RT Annual $**	**Projected Total $12,428** **RT % of Annual Total**
Annual Report Reference:	**#10, Page 36, R-37**	

OBJECTIVES: To determine whether electromyography of the human urinary bladder provides useful diagnostic and function monitoring information in the spinal cord injured patient.

The specific objectives are to determine if there is a quantitative relationship between bladder pressure, volume and electrical activity and whether this relationship is unique (diagnostic) in neurogenic and spastic bladders following spinal cord injury; to evaluate the effect of atropine and urecholine on the bladder EMG.

METHODOLOGY: We have recorded and measured the electrical activity of the human detrusor muscle during filling and emptying and have noted the rhythmicity of the potentials. We observed the mean potential duration of the waves as well as the amplitude. At the same time, we measured the changes in bladder pressure using cystometric methods. What we have intended to show is a correlation of abnormalities in cystometric measurements and abnormalities in the electrophysiological activity of the detrusor muscle.

Forty-five spinal cord injured patients with upper and lower motor involvement of the bladder and five control patients have been studied. In addition, some patients were followed with serial measurements. These procedures started within a short time after the spinal cord injury and were repeated as clinically indicated.

FINDINGS TO DATE: **Data analysis of the project to date** reveals the following:

Bladder electromyography has revealed distinct patterns for the various abnormal sub-groups which are separate and distinct from the control data. For patients with lower motor neuron bladders and absent bulbocavernosis (BC) or anal-cutaneous (AC) reflex little bladder EMG activity could be found. For patients with a positive bulbocavernosis reflex (BC+) but with cystometric evaluation compatible with a lower motor neuron bladder, decreased bladder electrical activity was noted. However, the activity was more than the first group. For patients with a positive bulbocavernosis reflex and a cystometric evaluation showing a pattern of upper motor neuron type bladder, increased bladder electric activity was noted. In patients with paralyzed bladders, whether they were upper or lower motor neuron bladders, a decrease in the electrical potential duration was noted.

In addition to these static characteristics the dynamic cystometric evaluation showed that as the pressure and volume increased the frequency and amplitude of the electric potentials increased and the duration decreased in hypertonic bladders. However, in hypotonic and lower motor neuron bladders the reduction in electrical activity was such that significant statistical correlations were not noted.

The electric potentials were unchanged with changes of position of the electrode; likewise, when one or two electrodes were implanted.

Atropine reduced but did not abolish electric potentials in upper motor neuron bladders. Urecholine increased electric potentials in lower motor neuron bladders whether those bladders were BC+ or BC−. The electric potentials are thus probably produced by the smooth muscle cells of the bladder wall.

APPLICABILITY: Urinary bladder problems of infection, stone formation, obstruction and hyperflexia are common and costly deterrants in rehabilitation of the spinal cord injured person. Many of these can be prevented or reduced by careful assessment of bladder function and correct management. Bladder EMG is a new sensitive and quantitative measure of neurogenic bladder type.

Jobs of spinal cord injured are interrupted all too frequently by the urinary tract problems indicated above and death occurs in at least 10% of these patients because of urinary tract infection and renal failure.

217 The Role of Neurotransmitters in Spasticity Genesis: Response to Reserpine and Nialamide

Principal Investigator:	**V. Sahgal, M.D.**	
Status:	**Completed**	
Dates:	**April 1976-March 1978**	
Cost:	**Annual $20,204** **RT Annual $13,873**	**Projected Total $58,791** **RT % of Annual Total 69%**
Annual Report Reference:	**#10, Page 58, R-38A**	

OBJECTIVES: The objectives of this study have been to critically review the literature in reference to this subject and to present new data concerning the alteration of neurotransmitters following spinal cord injury and relation of these changes to onset of spasticity in experimental animals.

METHODOLOGY: Twenty white rats were employed in the present study. All experimental animals were anesthetized with .1-.15 ml of Nembutal. In 16 rats, a laminectomy was performed at the level of the upper thoracic (T-6) level and the spinal cord was transected. Eight rats served as controls. The animals were killed 1, 3, 5 and 8 days after transection by means of intracardiac puncture to eliminate extensive bleeding into the spinal cord. Parts of the cervical, thoracic, and lumbar spinal cord were removed and frozen in Isopentane cooled with liquid nitrogen at −160°C. Tissues were then transferred to a Vir Tis Freeze Dryer (Model 10-800) and dried for three days at temperatures of −60°C and a vacuum of 5-10 microns. Tissues were treated with formaldehyde vapor for two hours at 65% humidity and then infiltrated with paraffin for 20 minutes in a vacuum oven at 30 pounds of pressure. The blocks were embedded in paraffin, stored in darkness, desiccated and sectioned (8 to 10u). Sections were mounted for fluorescence microscopy and were viewed with the Zeiss Photo-microscope II. Slides were made using High Speed Ektachrome film.

Sections of cervical, thoracic, and lumbar spinal cord were made of all rats and stained for cholinesterase activity according to the method of Koelle and Friederwall. Nissl, Luxol Fast Blue and H&E stains were also made on all sections to ascertain the general morphological integrity.

All animals were neurologically evaluated every 24 hours. A sensory examination using pin-prick was used to ascertain the level of the lesion. The state of flaccidity or spasticity following transection was evaluated by observation of the rat's gait or spontaneous movement, by passive motion of the extremities to monitor tone and rigidity, and by eliciting monosynaptic and polysynaptic reflexes.

FINDINGS TO DATE: In the present study, in the normal spinal cord of rat catecholamine fluorescence was observed in the anterior and lateral funiculi of the white matter throughout the spinal cord. In the gray matter highest accumulation of fluorescent fibers was seen in the intermediolateral column of the thoracic cord. At other levels, that is cervical and lumbar, maximal fluorescence was seen in the internuncial regions while in the ventral horn cells both green and yellow fluorescence was observed. This fluorescence was most prominent in the cervical and lumbar regions. Very little fluorescence was observed in the posterior gray zone.

Our results show that after complete transection of the thoracic cord the rat for the first 24 hours is in a state of spinal shock as evidenced by flaccid paralysis and loss of all sensations. This stage is followed 3 days later by a stage of flexor recovery manifested initially by mass reflex and later on by lateralized withdrawal. After two weeks the animal behaves like a typical spinal animal showing spasticity, placement reactions, skeletal deformities, and automatic bowel and bladder function.

Corresponding to the above clinical state 24 hours after transection, there was marked increase in fluorescence at lesion level (absent on saline perfusion) while below the level of the lesion the distribution remained normal. The cholinesterase distribution pattern showed a decrease in the activity of this enzyme at the level of the lesion and normal pattern below. This indicates that the stage of spinal shock might be related to this marked increase in catecholamines possibly blood element derived.

With the passage of time, (72 hours) below the lesion the catecholamine **fluorescence begins to decrease** and spasticity begins to set in. As time passes, up to three weeks in our studies the catecholamine fluorescence virtually disappears and the animal clinically shows evidence of spastic paralysis. Cholinesterase activity, however, showed a decrease only at the level of the lesion where a prominent gibbus was observed; while below the level of the lesion the distribution was normal.

The decrease in catecholamine fluorescence over a period of time after spinal cord transection has been previously observed by Carlsson et al (1963) and our observations correspond to theirs. Correlating the clinical neurological profile of the animal with the catecholamine distribution and cholinesterase activity indicates that a monoamine and quarternary amine interaction is important for normal motor function. Our study suggests that a decrease of catecholamine in the presence of normal cholinergic activity might form the pharmacologic basis for spasticity after spinal transection.

APPLICABILITY: The utilization of research results will involve physicians and scientists in medical and comprehensive rehabilitation medicine centers. The impact of the utilization of the data will be that the foundation has been broadened in understanding the relationship of neurotransmitters and spasticity; adding these informational building blocks will allow research decisions to be made about cause and development of effective agents to prevent or control spasticity in the rehabilitation setting.

218 Vocational Follow-Up of the Physically Restored Unemployed

Principal Investigator: **R. Sakalas, M.A.**
Status: **Completed**

Northwestern University

Dates:	**September 1976-August 1977**	
Cost:	**Annual $** **RT Annual $**	**Projected Total $35,937** **RT % of Annual Total**
Annual Report Reference:	**#10, Page 79, R-45A**	

OBJECTIVES: The purpose of this project is to confirm feasibility, demonstrate preliminary outcome and provide operating procedures for increasing vocational placement of the severely disabled **physically restored** who are **unemployed** (PRU), by use of a planned vocational follow-up program. The specific objectives are to:

1. Identify who the PRU are.
2. Select a cohort of PRU with highest probability of vocational placement and describe the criteria for selection.
3. Provide a comprehensive vocational service program to the cohort, directed at paid job placement; describe that program, including cost of service and potential sources of payment.
4. Determine success of the placement effort.
5. Determine the expected impact of a planned vocational follow-up program on PRU served by an average comprehensive medical rehabilitation center.
6. Describe the key procedural steps, time frame and problems to be anticipated in a model PRU vocational follow-up program.

METHODOLOGY: The project was executed in ten interlocking phased steps consisting of the following units:

1. **Population Identification**
2. **Sample Selection and Telephone Interviewing**
3. **Questionnaire Design**
4. **Questionnaire Completion and Analysis**
5. **Client Selection and Interview** — This phase consists of vocational counseling, identifying (through a newly developed Job Potential Readiness Scale - JPRS) client groups most appropriate for the vocational rehabilitation programs. It was composed of 13 subjects considered most appropriate for vocational counseling, work evaluation and placement. Seven subjects were selected for placement into the vocational evaluation program.
6. **Work Evaluation**
7. **Placement**
8. **Monitoring and Scale Revision**
9. **Evaluation**
10. **Dissemination**

FINDINGS TO DATE:

1. The newly developed Job Potential Readiness Scale (JPRS) consisting of five indicators (Transportation, Medical Status, Motivation, Self-Image and General Employability) was found to be valid (pl .001) when correlated with known vocational outcomes and ranks by VR counselors. "Predictive" power of the scale based on retrospective analysis was high: 98 percent of employed individuals scored greater than 195 (1 standard deviation above the mean) and 82 percent of unemployed scored below the cut-off point.

   Based on these very encouraging preliminary findings an improved scale and prospective validation will be undertaken in a definitive proposed project (PR-42B).

2. Seven of thirteen physically restored unemployed who met the criteria for "likely to succeed" in job placement were processed through the vocational counseling, work evaluation and job placement program (22 days, 132 hours). Six of the seven clients completed the program. Five of the six (83 percent) were placed in college or paid jobs at eight months follow-up. The demonstration sample consisted of three paraplegics, one quadriplegic, one right hemiplegic and one person with multiple sclerosis.
3. The most frequent problem interfering with job preparation and placement was lack of transportation.
4. A systematic, routine follow-up program will facilitate employment of the physically restored unemployed.

APPLICABILITY: The procedure studied and demonstrated in this project is clearly and directly related to maximizing the frequency and speed of vocational placement of the severely physically disabled by integrating the vocational follow-up procedure into the comprehensive medical rehabilitation process.

It is anticipated that the physically restored unemployed meeting follow-up vocational service selection criteria will be eligible for state-federal VR services and will, in fact, be a source of clients for the VR program.

Policy change implications include justification for third party payment of follow-up vocational services as an integral component of comprehensive medical rehabilitation. Of specific importance is the concept of need for early post discharge continuation of vocational services and the support and payment for those services by third parties.

219 Rehabilitation Functional Gain Per Unit Cost

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Completed**	
Dates:	**April 1977-March 1978**	
Cost:	**Annual $10,889** **RT Annual $8,457**	**Projected Total $20,635** **RT % of Annual Total 78%**
Annual Report Reference:	**#10 Page 153, R-62**	

OBJECTIVES:

1. To identify potential costs of rehabilitation by level of admission functional impairment.
2. To identify extent of functional improvement and cost according to types of service provided during comprehensive medical rehabilitation.

METHODOLOGY: Two-hundred and thirty-one physically disabled spinal cord injured (SCI) and cerebrovascular accident (CVA) patients were derived from 10 comprehensive medical rehabilitation centers (CMRC) in the United States. A theoretical cost-function indicator was developed using the Barthel Index measure of self-care and mobility. Theoretical assumptions were then tested with a large data set at 302 right and left hemiplegics and 271 traumatically injured paraplegics and quadriplegics from one CMRC. The cost and functional gain factors were expanded to include more refined service variables (e.g., physical therapy costs, gain in mobility). From these Barthel-Unit costs (cost of service divided by change in Barthel Score), or "BUC", were calculated and plotted according to functional level at admission or percentage of maximum possible functional improvement achieved.

FINDINGS TO DATE: The principle findings are:

1. The cost per unit increase in function of hemiplegic and spinal cord injured patients is four to eight times higher when 0 to 25 percent of maximum functional improvement is achieved, compared to when 51 to 100 percent is achieved. When plotted, a characteristic backward "J" shaped curve results. This means efficiency of rehabilitating low function achievers is very low. Certain quadriplegics and right hemiplegics are particularly inefficient candidates for rehabilitation.
2. Patients with Barthel admission scores of about 20 to 60 are more efficient rehabilitation candidates than those with scores of 1-20 or 61-100. In general, quadriplegics and right hemiplegics are the less efficient candidates.

APPLICABILITY: The findings of this study may be considered in future patient screening for admission to the Rehabilitation Institute of Chicago and other comprehensive medical rehabilitation hospitals. As more data accumulate in the REHABIS data base, more refined decision models can be developed to identify the potential favorable and unfavorable cost-benefit of rehabilitating a patient with a given set of characteristics, e.g., 32-year-old paraplegic, complete lesion, male with eighth grade education versus right hemiplegic, CVA, 52-year-old female with a college degree. Using such factors may provide more precise criteria for screening patients with the best potential for rehabilitation. More efficient alternatives than comprehensive inpatient rehabilitation may be necessary for some (e.g., selected services at home or even outpatient services.).

220 The Natural History of Deep-Vein Thrombosis in the Spinal Cord Injured

Principal Investigator: J. Yao, M.D., Ph.D.
Status: Completed
Dates: October 1976-June 1977
Cost: Annual $ Projected Total $13,475
RT Annual $ RT % of Annual Total
Annual Report Reference: #10, Page 167, R-63

OBJECTIVES:

Delineate the natural history of acute deep-vein trombosis in cord injured patients. Particular attention will be paid to: time of onset from time of injury, patient's age, sex, level of injury, completeness of injury, muscle tonus at onset of thrombosis, etiology of injury, associated major injuries and operations, and medical illness that might predispose to thrombosis (e.g., congestive heart failure or history of venous insufficiency).

Compare deep-vein thrombosis incidence using these simultaneous assessment techniques: clinical evaluation, Doppler venous flow studies, impedance plethysmography (IPG), and radioactive ^{125}I fibrinogen scanning and venography (contrast or isotopic), if indicated. Determine the frequency of complications of venous thrombosis such as fatal and non-fatal pulmonary embolism.

METHODOLOGY: Each patient must have spinal cord damage and must have no significant trauma to the lower extremities or pelvis that would make the assessment techniques physically or technically infeasible.

Each patient will be examined upon admission and the pertinent historical and physical findings noted. Each patient will receive a battery of tests within 24 hours after admission: 1) clinical assessment for deep-venous thrombosis, 2) Doppler venous flow studies (Yao and Bergen, 1974), 3) impedance plethysmography (Yao, et al, 1974), and 4) ^{125}I fibrinogen scanning (Todd, et al, 1976). The non-invasive tests (IPG and Doppler) will be provided by the Blood Flow Laboratory (NMH), while the ^{125}I fibrinogen uptake test will be done by the Nuclear Medicine Department (NMH). These tests will be repeated each day of the study, until either the patient develops evidence of deep-venous thrombosis or he has had two negative scanning periods. (If the first scanning period, 7-10 days, shows no evidence of thrombi, the patient will be re-injected and studied for a second period). If after two scanning periods (14-20 days), the patient has not developed venous thrombosis, he will be discontinued from the study. If the Doppler or IPG are positive and the scan is negative, the patient may have a phlebogram for confirmation of the diagnosis (at the discretion of the attending physician). All positive results will be relayed to the attending physician and the decision for treatment will be his.

FINDINGS TO DATE: Analysis of the results of the study, in which 12 patients were included, demonstrated the following:

1. One patient died of cardiac arrest six days after injury; the contributing cause of death, if any, was unknown.
2. Venous thrombosis was detected by 125I-fibrinogen scan in nine of eleven patients (82 percent). The impedance plethysmograph detected venous thrombosis in six patients (54 percent), while the Doppler technique found abnormal venous flow in only three patients (27 percent). Clinical examination at the bedside by nurses and physicians revealed deep-vein thrombosis in no (0 percent) patients.
3. Venography as the definitive test for venous thrombosis was used in only five patients. All five patients (100 percent) had venous thrombosis documented by venography; all five patients (100 percent) had positive 125I-fibrinogen scans; three of five (60 percent) had positive IPG; two of five (40 percent) had positive Doppler response; none of the five had clinical signs/symptoms of thrombosis.
4. On the basis of 125I-fibrinogen scan, the first signs of deep-vein thrombosis in the leg occurred three days post-injury. In one patient evidence of thrombosis was found 20 days and in another 32 days post-injury. The average time of onset of "thrombosis" in this small sample was 9.6 days post-injury, as detected by 125I-fibrinogen scan. In the five patients with positive venograms the mean duration post-injury was 8.6 days. In the same five patients, 125I-fibrinogen became positive at 7.2 days. These data on mean onset time must be considered only tentative because of the small

principle.

APPLICABILITY: Deep-vein thrombosis of the legs occurs rather frequently during the first three months following spinal cord injury; more often than had been apparent. When a piece of this thrombosis breaks off, it lodges in the lung, blocking an artery and leading to lung tissue damage and occasionally death. When deep-vein thrombosis occurs during rehabilitation it stops rehabilitation until the threat is well under control, often a period of weeks. We are attempting to understand when and how this thrombosis occurs so that it can be prevented.

On the basis of this pilot study, RSA has funded through non-RT center funds (13-P-59111/5) a three-year study entitled "The Study and Treatment of Deep-Vein Thrombosis in the Spinal Cord Injured." The definitive research project product is expected to be a reliable and valid natural history description of deep-vein thrombosis in the first 30 days after spinal cord injury as well as rational plan for early detection and/or prevention of deep-vein thrombosis on the basis of the natural history and several new alternative methods of intervention.

221 Conceptual Model of Planning and Evaluation of Rehabilitation Services

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Continuing**	
Dates:	**August 1975-August 1978**	
Cost:	**Annual $35,413** **RT Annual $28,601**	**Projected Total $77,321** **RT % of Annual Total 81%**
Annual Report Reference:	**#10, Page 68, R-39**	

OBJECTIVES:

1. To develop and refine a theoretical model that incorporates the parameters of time scale, life function scale, agents involved in the process of rehabilitation, disability conditions.
2. Develop a set of standardized scales and/or indicators measuring relevant life functions (e.g. mobility, self care, work adjustment) to measure changes that occur during the process of rehabilitation.
3. Develop a computer based simulation system that would incorporate the various components of the model to test and evaluate its practicality.
4. Based on the conceptual model and its simulation system by computer a model for planning, management and evaluation of rehabilitative services would be built and machine generated cost and life function indicators would be developed to serve as aids in the planning, delivery and evaluation of rehabilitation services.
5. Develop and maintain a computer accessible standardized data base on four disability groups that will provide the "real world" base for the model as well as serve various empirical investigations.
6. Based on normative information, modes of rehabilitation derived from the model would be presented. Data base analysis and evaluation of the rehabilitative process from a cost benefit and cost effectiveness modes would be made and alternative modes of rehabilitation would be presented.

METHODOLOGY: The individual project components follow.

1. Structuring of the theory
2. Modification of life function scales.
3. Empirical data collection.
4. Data Normalization.
5. Development of prototype simulation model (trajectory and parameters).
6. Development of four disability comparisons model (trajectory and disabilities).
7. Development of a rehabilitation agency and activities simulation model (trajectory X disability X agents-agencies).
8. Development of an integrated systems approach.

FINDINGS TO DATE: Work in the current reporting period was in the areas of model structuring, life scale modification, data collection, data normalization and simulation model structuring.

To date, coding of over 3,000 RIC patients has been made. Of these, 600 are categorized as spinal cord injured (both paraplegic and quadriplegic), 1,400 are hemiplegic, 150 are identified as amputation and 1,150 are of varied disability categories (e.g., non-traumatic paraplegia and quadriplegia, 300; cerebral palsy, 70; cerebral trauma, 90).

In addition to the core 183 REHABIS variables collected on all subjects, study specific factors concerned with patient vocational, psychological, and recreational adjustment are being monitored on a patient sampling for both the rehabilitation phase and post-discharge; these include such instruments as MMPI, WAIS, Bender, on over 1,000 patients.

The scaling approach by means of multiple regression analysis was utilized in exploring factors that could be predictive of successful vocational rehabilitation. The JPRS (Job Potential Readiness Scale) combined psychological, motivational, and environmental factors, in a scaled subset, to isolate the variables that were statistically different between those who were unemployed versus employed.

A paper, titled "The Predictive Validity of Certain ADL Items as They Relate to Occupational Therapy Service in comprehensive Medical Rehabilitation", was presented at the National Occupational Therapy Conference. Analysis indicated that two specific ADL items could be isolated at patient entry to the rehabilitation phase that would be predictive of overall functional gain; they related to fine and gross motor control.

Treatment delay related to functional outcome for hemiplegics was the subject of another paper presented at the National Occupational Therapy Conference. This paper presented the specific hypothesis test that hemiplegic patients with shorter treatment delays (duration between onset of hemiplegia and initiation of a rehabilitation program) will achieve greater gains in the areas of self-care and upper extremity function than individuals admitted to rehabilitation after a longer period has elapsed since the time of injury. A sample of 444 right and left hemiplegic patients with delays of 1-30 days, 31-60 days, 61-90 days, and greater than 90 days were used in this study. The dependent variables were the amount of functional improvement from admission to discharge and the actual discharge level of function as measured by the Barthel Index, and several other functions. A statistically significant effect was found confirming the posed hypothesis.

The function model, relating an individual patient's performance over time, underwent further restructuring in terms of classifying both the quantitative and qualitative factors that comprise measures of rehabilitation process and outcome. A computerized outputting model, utilizing actual case data, was used to generate a graphic representation of function of patient profile. The profile was used across part of the functional vectors to describe the progress of the patient over time from admission to discharge to follow-up.

Further conceptualizing dealing with the evaluative usage of the model was presented at the National Occupational Therapy Conference. This paper deals with the use of the model to evaluate rehabilitation process and the evaluation of rehabilitation effectiveness. By means of the model's normative structure across the components of performance, effort, efficiency, adequacy, many varied observations, received through an established data collection system, can be recoded into more concise forms. Circular graph profiles can be generated to compare various aspects (vector patterns) of "Effectiveness Criteria" concerning one individual, one group, or various groups of individuals.

In addition, a preliminary analysis of current and long-range costs and long-range benefits of comprehensive rehabilitation was completed. The analysis was done for traumatically injured paraplegics and quadriplegics and, within both groups, for men and women separately. The results indicated that a return of about two dollars can be expected from each dollar spent on "comprehensive" treatment compared alternative "average" treatment based on physical and occupational therapy in the general hospital.

A similar cost benefit comparison was undertaken for focal cerebral patients. Preliminary results show that re-employment and self-care benefits realized produce a much smaller present benefit differential for comprehensive care even before their tabulation over the life span. One apparent conclusion is that focal cerebral comprehensive rehabilitation candidates need to be carefully selected.

Models for evaluation of medical rehabilitation have not been developed to the point where cost of choice of rehabilitation modality can be assessed. Increasingly the choice is really when and how much to augment the basic therapies with supportive procedures, such as psychological and social work counseling, and in-house vocational rehabilitation. With this fact in mind, a system of two term equations has been developed to permit finding the difference in inputs and outputs on each parameter. Central benefits considered are costs avoided for rehospitalization, self-care costs avoided, and increased earning power. The model allows the expression of each benefit on a discounted basis in terms of relevant outcome units, as well as cost units. This will permit cost-effectiveness comparisons between benefits and the calculation of non-priced output trade-offs within the model on a present valued basis.

The structuring of a total system model underwent considerable development over the past three years. The ultimate goal is to enter a patient's demographic and psychosocial characteristics and, by means of a simulation model, information pertaining to outcome cost and functional status would be generated.

APPLICABILITY:

Facility Mangement. The demand for cost efficient operations requires management structures where alternate decisions have a best fit in a given budget. A theoretical service model grounded by an empirical data base and designed for machine simulation would facilitate management of rehabilitation systems.

Teaching. From the standpoint of teaching rehabilitation science, a theoretical model of rehabilitation is needed to facilitate conceptualization of the rehabilitative process and to illustrate and interrelate such concepts as: prevention, trauma, rehabilitation, habilitation, exceptionality and process monitoring, recovery curves, trauma and decreased efficiency curves, functional efficiency profiles, systemic interrelationships and normalizations of curves for handicapped and non-handicapped populations.

Research. On the basis of the theoretical model, programmatic research could be conducted more efficiently because model simulation would be based on theoretically and empirically derived environmental inputs, empirical grounding and heuristics. By means of this model a set of recovery rates with alternate rehaiblitative environments, different disability groups and different agents operating on the disabilities could be simulated and compared with practice in the "real world" environment for more effective research problem solving.

Patient-client management. In patient-client management environment, (e.g., physical therapy, rehabilitation counseling), knowing the types of differential probabilities of success for given individuals, disabilities, and rehabilitatin methods would facilitate the selection of alternatives providing the most successful outcomes.

222 Prevention of Urinary Tract Infection in Spinal Cord Injury

Principal Investigator:	**Y. Wu, M.D.**	
Status:	**Continuing**	
Dates:	**April 1976-September 1978**	
Cost:	**Annual $18,997** **RT Annual $15,479**	**Projected Total $35,810** **RT % of Annual Total 82%**
Annual Report Reference:	**#10, Page 121, R-46**	

OBJECTIVES: This project is divided into two major objectives:

A. **Evaluation of the dynamic mechanism of the bladder against infection.**

B. **Development and evaluation of devices which facilitate bladder infection prevention and/or management.**

METHODOLOGY:

A. Evaluation of dynamic defense mechanism of bladder against infection. Confirm CURDT formula in vivo in spinal cord injured subjects with neurogenic bladder.
   1. Measurement of post-catherization residual urine volume.
   2. Evaluation of bacterial doubling time in bladder. Determine effect on bacterial doubling time of anti-bacterial agents.

B. Development and evaluation of devices which facilitate bladder infection prevention and/or management.

1. Clinical evaluation of RIC catheter kit.
2. Develop and evaluate home monitoring system for bacteriuria.
3. Develop and evaluate home catheter sterilization procedure.

FINDINGS TO DATE:

Measurement of post-catheterization residual urine volume and its relation to extent of bacteriuria. It was discovered that it was unnecessary to carry out this test procedure because small volumes (less than 10 cc) do not significantly contribute to maintaining bacteria in the urine. Because the expected residual urine volume following catheterization is less than 10 cc (normal individual's voiding residual is less than 1 cc), with a bladder capacity of 300 cc the dilution ration (bladder capacity divided by residual urine) is much greater than 30 times. From the RIC Bladder Graph the Safe Emptying Interval then would be longer than the time period between intermittent catheterizations. Thus sterile urine can be achieved or maintained when the patient is on a q4h intermittent catheterization program, despite a residual of 10 cc or less.

In vivo bacterial doubling time. The bacterial doubling time is one of the major factors that affects the Safe Emptying Interval and hence the ability to clear the urine of bacteria. The actual doubling time in vivo depends on the type of organism, the use of anti-bacterial agents and the residual urine volume (which, if large, reduces the chance of suppression of bacterial growth by contact with the bladder mucosa). The in vivo doubling time of the common organisms (e.g., E. Coli, Pseudomonas, Klebsiella, etc.) is 35-46 minutes.

Effect of instilled anti-bacterial agents on bacterial doubling time. Because it is difficult to find patients with bacteriuria on intermittent catheterization, a modified method is now being tested in the laboratory with the use of a simulated bladder. Both sterile urine and broth are being tested as culture media. The problem of in vivo measurement of doubling time, with or without anti-bacterial agents, delayed completion of the project to September 1978.

Evaluation of the RIC-Wu Catheter Kit. Initial, clinical evaluation of the RIC-Wu Catheter Kit compared to the conventional (Bard) kit has been completed in ten patients.

Preliminary results indicate that the vast majority of the nursing staff find the RIC-Wu Catheter Kit more convenient and quicker to use than the conventional kit. Further, the nursing staff who observed patients during self-catheterization feel that patients find the RIC-Wu easier to use.

Most of the patients and nurses noticed the following advantages: less chance of contamination, portable, accessible from the wheelchair, fewer steps and faster, easy teaching and learning, less professional time involved, and less material needed.

Home catheter sterilization procedure. Various chemicals and a boiling technique for sterilization of the Reusable Penrose Catheter were evaluated. It was found that Betadine is a reliable chemical for sterilizing the catheter and also for lubricating it. Alternatives are available, such as H_2O_2 and boiling in a pressure cooker, but then additional lubricant is needed.

APPLICABILITY: The possible procedure changes could be:

a. Shift from use of current expensive and inconvenient catheter set to RIC Catheter Kit. (The Illinois Tool works has applied for a patent for the RIC-Wu Catheter Kit and has been marketing it nationally since early in 1977.)
b. Routine determination of bacterial doubling time and use of bladder emptying frequency chart in bladder management.
c. Broader use (or non-use) of bladder additives to prolong bacterial doubling time.
d. Method of home sterilization of the intermittent catheter.
e. Method of home-determination of urine sterility.

223 Post Rehabilitation Problems and Costs

Principal Investigator:	**S. Harasymiw, Ph.D.**	
Status:	**Continuing**	
Dates:	**April 1977-March 1979**	
Cost:	**Annual $65,205** **RT Annual $53,165**	**Projected Total $79,068** **RT % of Annual Total 82%**
Annual Report Reference:	**#10, Page 139, R-60**	

OBJECTIVES: The overall purpose of this project is to study severely disabled individuals during the rehabilitation post-discharge period to determine why some patients are maintaining successful adjustments while others require multiple hospital readmissions. The specific objectives are to:

1. obtain an accurate knowledge (type and rate) for each major disability of follow-up stresses and complications in medicine, mobility, self-care, work adjustment and performance, involvement with family and significant others;
2. identify ways that patients have adjusted to problems arising post-discharge and identify techniques that can prevent complications and facilitate adjustment in other patients;
3. compare the needs, costs and recovery stages of the disabled who have gone through rehabilitation on first admittance and those of patients who have had several readmissions.

METHODOLOGY: The subjects for this study will consist of 320 randomly selected RIC patients discharged in 1976, 1977 and 1978. Dichotomus classification will be made in terms of patients who are **first admits** and **readmits**, regardless of the reason for readmittance. Patients will be categorized under the major categories of spinal cord injured, focal cerebral and "other".

The instruments for data collection are specially designed questionnaires to be administered through telephone and personal interviews.

Initial patient functional performance data at admission and at discharge will be taken from the Rehabilitation Information System (REHABIS) for patients discharged in 1976, 1977 and 1978. The information consists of demographic data, type and extent of impairment, type and extent of disability, type, amount and cost of services provided. REHABIS also has the capacity to input post-discharge follow-up data relevant to continuing handicapping conditions, vocational placement or extent of independent living and the amount and cost of continuing services. Home visits are also being made by research staff in instances where data is not otherwise available.

FINDINGS TO DATE: Data from the initial pre-discharge interview with 101 patients have been entered into the computer. These data primarily measure the patient's pre-morbid set and give a picture of the factors in the patient's life before the injury or illness, as well as information relating to their experiences in rehabilitation and expectations for future adjustment.

The data set from patients was correlated with the Prognosis Indicator Instrument which was administered to the social work staff. Test re-test reliability of the prognosis instrument over a one and a half month period was correlated at a level of .48 with a significance of .002. Some of the preliminary findings indicate that patients with high risk probability for planned readmission tend to have a lower income than low risk patients, that high risk patients are more often unmarried than low risk patients and that high risk patients are less involved in social and community activities than low risk patients. This information will assist in the eventual development of a set of predictor items from both patients and social workers which identify high risk patients. Then improved techniques and more intensive monitoring can be established in order to prevent costly readmissions.

APPLICABILITY: It is anticipated that the close involvement of the RIC Social Work Department in the project will facilitate further dissemination and implementation of programmatic changes into the department's service delivery system. If service delivery modifications are implemented in an operating system, a much more efficient model can then be devised.

Policy change implications include third-party payments of follow-up services as an integral component of comprehensive medical rehabilitation. Of specific relevance is the concept of appropriate discharge point and monitoring of patients post-discharge to estalish a preventive maintenance linkage with those patients who are specifically identified as high risk.

224 Therapeutic Recreation Outcome

Principal Investigator:	**A. Rubin**	
Status:	**New**	
Dates:	**October 1977-September 1979**	
Cost:	**Annual $32,928** **RT Annual 32,928**	**Projected Total $46,386** **RT % of Annual Total 100%**
Annual Report Reference:	**#10, Page 175, R-72**	

OBJECTIVES:

1. To examine the type and degree of patient participation in therapeutic recreation activities and to develop a scaled measure of this participation.
2. To develop an index of social adjustment which will reflect patient functional performance in the physical and social environment considered relevant to therapeutic recreation expected outcomes.
3. To determine if there are inter-relationships between type and frequency of participation in therapeutic recreation activities and patient functional performance during and following rehabilitation.
4. To determine the cost of rehabilitation intervention in general and participation in therapeutic recreation in particular and determine the relationships between costs and adjustment outcomes.
5. To identify formal therapeutic recreation follow-up procedures for patients leaving the rehabilitation setting that will optimize social and recreational achievement by the disabled in the community.

METHODOLOGY:

Subjects: The sample population for this two-year study will consist of 300 subjects who will all have been treated as first admission inpatients at RIC between 1975 and 1978. The longitudinal sampling will consist of 150 first inpatient admissions interviewed between March and July 1978. A cross-sectional sample will include 150 subjects who were first inpatients at RIC in the years 1975, 1976 and 1977.

Procedure: Much of the clinical information is accessible through REHABIS (computer-based patient information system) at RIC and the therapeutic recreation participation files. Only minor retrieval of data sets will be necessary.

Data Collection Instruments: The data for this study will be gathered from four major sources: (1) REHABIS (containing medical, physical, psychosocial, costing, vocational and economic data), (2) Therapeutic Recreation records (type and frequency of patient participation), (3) Therapeutic Recreation Activity Scale (an instrument to be developed during the course of the project that will provide process evaluation information on therapeutic recreation participation) and (4) Patient Interview Forms (collection of relevant psychosocial and rehabilitation outcome information not contained in the three previous data sources).

FINDINGS TO DATE: An initial exploratory study has already been completed (Harasymiw, et.al., 1977). The intent of this exploration was to identify the kinds of therapeutic recreation activities that physically disabled patients participated in and to quantify this participation. The study sample consisted of 50 inpatients treated at RIC between January 1975 and February 1977. A data base was established that monitored such variables as Therapeutic Recreation participation, functional assessment and medical/diagnostic status.

The initial data analysis seemed to indicate that participation in the Therapeutic Recreation program tended to be consistent in pattern throughout the study period (10 weeks). The degree of participation in "active" recreative programs increased progressively with the patient's gains in functional ability. In-house activities were marked by a steady increase in recreational activities to about the mid-portion of the study, at which time a plateau was reached. This preliminary exploration attempted to provide better understanding of the Therapeutic Recreation process. It also demonstrated the feasibility of integrating and analyzing multi-source data into a composite data base.

At time of report, 40 longitudinal and 16 cross-sectional interviews had been completed. Data analysis will be reported subsequently.

APPLICABILITY: The information generated from this study will be used principally in the planning of recreation programs in clinical rehabilitation settings. Community recreation managers will also find a use for this information in their programs for the physically disabled.

Policy change implications include third-party payments for follow-up services as an integral component of comprehensive medical rehabilitation.

225 Idiopathic Scoliosis: Structural and Chemical Pathology

Principal Investigator: **V. Sahgal, M.D.**
Status: **New**
Dates: **October 1977-September 1978**

Northwestern University

Cost: **Annual** **Projected Total $16,788**
RT Annual **RT % of Annual Total**

Annual Report Reference: **#10, Page 185, R-98**

OBJECTIVES: To determine and quantitate the structural and chemical characteristics of para spinal muscles in patients with progressive idiopathic scoliosis.

METHODOLOGY:

Subjects: Twenty patients with progressive idiopathic scoliosis who have been selected for surgical correction of the spine will be investigated. Patients will be examined by the orthopaedic service with regard to the specific site and angle of back curvature; special attention will be paid to the status and symmetry of the axial and appendicular musculature. Muscle strength will be graded on a scale of 0-5. Patients with muscular dystrophy or suspected associated neurological disorders will be excluded. The first 20 patients selected for corrective surgery and consenting to muscle biopsy will be studied.

Muscle Biopsy: Muscle biopsy samples will be taken from the para spinal muscles of patients undergoing surgical correction of scoliosis at the following sites:

1. Above the apex of the curve. Convex and concave side.
2. At the apex of the curve. Convex and concave side.
3. Below the apex of the curve. Convex and concave side.

Muscle samples will be taken far from the tendinous origin of the muscles to avoid misinterpretation due to normal changes at the myotedinous junction.

Morphology: The muscle samples will be oriented transversely and longitudinally. These specimens will then be frozen in isopentane chilled in liquid nitrogen, and 8-10 u serial sections cut in an International cryostat. The sections will be stained with hemotoxylin, eosin, and modified gomori trichrome. Sections will be viewed by two independent viewers.

Histochemistry: Frozen sections will be treated for the following reactions according to the previously discussed techniques (Sahagal, et.at., 1975, 1976, 1977):

1. Myofibrillary ATPase - pH 9.4 and 4.4
2. NADH diaphorase
3. PAS
4. Sudan Black

With the above reactions, Type I and Type II fibers will be recognized.

Morphometrics: The diameter of the fibers and histograms will be plotted according to the methods of Brooke and Engel, 1969.

From this data, atrophy and hypertrophy factors will be calculated (Brooke & Dubowitz).

Statistical Analysis and Interpretation of Data: The changes in the fiber types and size at the apex, above and below, as well as the concave and convex side of the scoliotic curve will be compared using standard statistical techniques (e.g., Student "t" test). For ech patient and the group as a whole the "control" muscle will be considered that specimen above the level of the scoliotic curve. At this time a separate non-scoliotic "control" sample is not being considered.

FINDINGS TO DATE: As per the proposal, muscle specimens from 10 patients (9 females and 1 male) with idiopathic scoliosis of greater than 45 degrees have thus far been examined. Specimens were taken from the convex and concave sides of the curve above, below, and at the apex of the scoliotic curve. Whenever possible, a proximal muscle (Gluteus maximus) was also examined. The muscle examined were the deep and superficial paraspinals. For the purposes of comparison, the specimens from above the curve were considered normal.

Morphology: The most consistent morphological finding was variation in fiber size at the level of the apex of the curve, more on the concave than the convex side. In two cases, evidence of structural abnormality such as central nuclei, granular change, and hyalinization was seen. In both of these cases, the curvature was greater than 65 degrees. Fiber splitting was occasionally observed. Group atrophy was significantly absent in all cases.

Histochemistry: The most outstanding histochemical finding was selective atrophy of both type IIa and b fibers (ATPase reaction) which was maximal at the apex of the curve with predominant change on the concave side. The percentage distribution of Type I and Type II fibers showed a decrease in the number of Type II fibers at the apex of the curve as compared to above and below the lesion. In one patient (the only male patient) there was an increase in Type II fibers at the apex of the curve. The gluteus maximus and the trapezius muscle were normal (morphologically and histochemically) in all of the cases. Muscle spindles were observed in 10 specimens representing at, above, and below the apex of the curve on both sides. No morphological abnormality was observed in the muscle spindles. The myoneural junction could be examined in three specimens and was morphologically normal.

In summary, in our patient population the abnormal findings were observed at the apex of the curve and consisted of selective Type II atrophy.

APPLICABILITY: The utilization implication of the findings of this study will be for a rational basis for diagnosis and ultimate clinical management of idiopathic and perhaps secondary scoliosis. The principal immediate use will be for establishing the basis of the pathologic mechanism causing scoliosis.

RT
OC

Texas Tech University (RT-21)
Research and Training Center in Mental Retardation

CORE AREAS OF RESEARCH DISSEMINATION/TRAINING

Work Potential of the Retarded

An exploration of the capacities for employment of mentally retarded persons including those not traditionally eligible for vocational rehabilitation services.

Counseling the Mentally Retarded and Improving Service Delivery

Central to this core is the role of the counselor in habilitating mentally retarded clients. It has been broadened to include research which evaluates rehabilitation programs toward the end of improving service delivery.

Research on the Special Needs of the Mentally Retarded with Multiple Handicaps

Activities which include special studies of the blind retarded and deaf retarded.

Deinstitutionalization and Community Adjustment of the Retarded

Exploring key variables associated with successful community adjustment of the retarded and dealing with social skill training, community attitudes and community based residential facilities.

TEXAS TECH UNIVERSITY

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PROJECT TITLES BY FY 1978 STATUS

COMPLETED **ABSTRACT NO.**

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Delegation of Homemaking Responsibilities to the Mentally Retarded in Three Environments (J. Coulter, Ed.D.) 227

Effects of Special Olympics Participation on Retarded Children, Families, and Community (A. S. Martin, Ph.D.) 228

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PROPOSED

Applications of Behavioral Training Strategies with the Mentally Retarded in Sheltered Work Settings

Predicting Future Trends in Rehabilitation of Mentally Retarded Persons

Program Evaluation for an Integrated Community-Based Extended Rehabilitation Service System

Student Sex as a Factor Influencing Job Placement of Cooperative School Program Students

Increasing Parent and Caretaker Effectiveness in Understanding and Dealing with the Sexual Development of the Retarded

Concepts of Time in the Retarded and Hearing-Impaired Retarded

226 Developing an Empirically-Based Training Program in Mental Retardation

Principal Investigator:	**Jerry D. Parham, Ph.D.**	
Status:	**Completed**	
Dates:	**March 1973-September 1977**	
Cost:	**Annual $50,828** **RT Annual $34,577**	**Projected Total $121,020** **RT % of Annual Total 68%**
Annual Report Reference:	**# 7, Page 90, R-13**	

OBJECTIVES:

1. To determine training needs of staff working in the field of rehabilitation of mentally retarded persons.
2. To develop and test programmed instructional materials and curriculum guides to meet these training needs.
3. To train rehabilitation personnel in the use of these materials and training programs and in their incorporation into staff development plans.

METHODOLOGY: Surveys have been taken of approximately 200 agencies serving mentally retarded persons to determine training needs. Development of training materials begins with a review of the literature and available training materials. Materials developed by Center staff are field tested and revised before publication in final form.

FINDINGS TO DATE: Survey data from rehabilitation agencies have been analyzed to determine specific areas of training needs for rehabilitation personnel. A three-part slide/tape presentation with a written supplement, "An Orientation to Mental Retardation for the Vocational Rehabilitation Counselor," was produced in 1975.

An instructor-free training package, "Individual Program Planning with the Developmentally Disabled," was completed in 1976. The package consists of two 1-hour videotapes, individual workbooks for the trainees, and a booklet, "How to Implement and Maintain an Individual Program Planning System," which contains guidelines for administrators on implementing the training as well as the system.

A study of the effectiveness of programmed instruction for training paraproffessionals in helping relationships was completed in 1976, and the results are scheduled for publication in monograph form.

APPLICABILITY: The training materials developed can be used in staff development programs. While this research project was completed in 1977, the development of empirically based training materials will continue at RT-21. Self-instructional training packages are planned on program planning and evaluation, treatment strategies, motor development training for paraprofessionals, and on training paraprofessionals as communication aides.

227 Delegation of Homemaking Responsibilities to the Mentally Retarded in Three Environments

Principal Investigator:	**Jane Coulter, Ed.D.**	
Status:	**Completed**	
Dates:	**March 1973-September 1977**	
Cost:	**Annual $9,175** **RT Annual $5,175**	**Projected Total $26,320** **RT % of Annual Total 56%**
Annual Report Reference:	**# 7, Page 239, R-16**	

OBJECTIVES:

1. To compare three types of environments — the institution, the group home, and the natural home in terms of the extent to which they involve mentally retarded teenagers and young adults in the management and performance of homemaking activities.
2. To uncover reasons underlying any reluctance of caretakers to delegate homemaking responsibilities to mentally retarded individuals.

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3. Based upon findings, guidelines will be developed for use by parents and other caretakers who train the retarded.

METHODOLOGY: A questionnaire covering 65 distinct household tasks organized under 7 headings was developed in order to determine the extent to which the retarded participate in homemaking tasks and, at the same time, the extent to which they require supervision while performing such tasks. The instrument was completed by three types of caretakers of retarded teenagers and adults: parent, houseparent, or attendant. Respondents were asked to indicate the frequency of the retarded individual's involvement in each task (never, 25%, 50%, 75%, or 100% of the times the task is completed by anyone in the household). The questionnaire also asked for reasons for lack of participation in tasks, the extent of parental prompting required before the retardate begins each task, and the amount of supervision required as the individual works at the task. Parents of normal school children also completed the questionnaire, providing an external standard by which to compare the retarded subjects' amount and type of homemaking participation.

FINDINGS TO DATE: The following groups of subjects constituted the final, usable sample for the study. (1) Trainable School: N=52 students in a public school for trainable children, with a mean age of 14.77 and mean IQ of 42.33; (2) State School: 163 residents of a public institution for the mentally retarded with a mean age of 18.74 and a mean IQ of 49.15; (3) Workshop: 20 adults, male and female in vocational training at a private community center for the mentally retarded, mean age, 22.05; mean IQ 60.85; (4) Educable School: 19 students in a school for educable children at the same private center for the mentally retarded, mean age, 13.68; mean IQ, 61.37; (5) Community Residential Facilities for Adults: 33 adults in five community settings including group homes, and halfway houses for mildly and moderately retarded individuals; (6) Normal School Children: 74 students in a small town school system. Mean age, 13.15; IQ, not available, but in the normal ranges.

Statistical analyses revealed that the highest homemaking scores among the mentally retarded were obtained by the Workshop sample, the Educable School Group, and the Community Residential Facility sample. Despite a lower mean IQ and age, the Trainable School group scored somewhat, but not significantly, higher than the State School group. Further analysis of matched subgroups living at home and in the institution pointed to a lack of homemaking opportunities in the institutional setting, but both of the more severely retarded groups were significantly less involved in homemaking tasks than were the other groups. Although the normal school children had the highest mean score, they were not significantly more active in homemaking tasks than the higher scoring mentally retarded groups.

A conceptual distinction was made between performance and managerial tasks. All groups were more involved in performance tasks than managerial tasks. However, the normal children had the broadest range of participation and appeared, in many cases, to distinguish themselves from the retarded by their higher involvement in managerial type tasks.

Correlational analysis indicated that older children and adults tended to have higher total homemaking scores, as did those subjects with higher IQs. Furthermore, subjects in all groups who tended to need both more urging to begin a task and supervision while performing the task appeared to participate less in homemaking activi[illegible]s.

In light of recent concern with sexism, an analysis w[illegible] undertaken to ascertain the extent to which homemaking participation of the retarded is gove[illegible]d by sex-role stereotypes. Independent rates classified the questionnaire items as male-ste[illegible]ped, female stereotyped, or not sex-typed strongly in either direction. Analysis revealed t[illegible]hile males and females did not differ significantly in their overall participation in homema[illegible]g chores, they did differ in the types of tasks in which they participate, and these differences w[illegible]e consistent with predictions based on sex-role stereotypes. Though homemaking participation was also examined in relation to selected family background variables, multiple regression analyses demonstrated that family characteristics were not predictive of homemaking participation.

Overall, the findings suggested the need for raising expectations among parents and caretakers as to the potential of the mentally retarded for assuming homemaking responsibilities. Opportunities to participate in homemaking activities, including those traditionally associated with the opposite sex, could profitably be expanded for persons of all IQ levels, particularly those in institutions, as training for independent functioning in adulthood.

APPLICABILITY: This study supplies needed information and material to vocational rehabilitation personnel and trainers and educators of the mentally retarded. In particular, it helps in identifying critical areas of homemaking in which the retarded need training and guidance. Data collected in the study also are useful in the development of curriculum guidelines which rehabilitation personnel can make available to the retarded or supply to their parents or other caretakers — materials which can aid them in adjusting to their living environment and thereby increase their chances of success in the community.

228 Effects of Special Olympics Participation on Retarded Children, Families, and Community

Principal Investigator:	**Andrew S. Martin, Ph.D.**	
Status:	**Completed**	
Dates:	**November 1974-October 1977**	
Cost:	**Annual $91,474**	**Projected Total $173,010**
	RT Annual $2,544*	**RT % of Annual Total 2.8%**
Annual Report Reference:	**# 7, Page 250, R-24**	

***These are FY 1977 figures—no fiscal data are reported for completed projects.**

OBJECTIVES: To conduct an experimental study of the impact of the Special Olympic Programs to determine what changes are occurring to the mentally retarded participants that can confidently be attributed to the program itself, and are not attributable to the multitude of other events occurring daily at home, at school, in the community, and even at the State-Federal level.

METHODOLOGY: The study has two major foci: (1) Impact of Special Olympics participation upon the mentally retarded children, their parents and teachers, and the effects on the community, and (2) The administration of the National Special Olympics Program.

I. The impact of Special Olympics participation is being studied through a repeated measures design with four communities which had no previous Special Olympics involvement. In two communities (experimental communities), experimenters established Special Olympics Programs, and two communities remained as controls. Repeated measures in each community over the three-year longitudinal study include: physical, achievement, and personality measures of the students themselves; teacher evaluations of students; progress data from existing school records; parental reports of home behavior of the student, degree of parental participation and attitudes toward programs for the retarded; professional services provided for the retarded; monitoring of community newspapers, city council meetings, and activities of community groups; and several unobtrusive measures of community attitudes.

II. Questionnaires were sent to the 50 state directors and included questions in the following areas:

1. What elements make up, and are necessary for a successful Special Olympic Program;
2. Evaluations and recommendations in terms of the present training program for mentally retarded students as outlined in the Special Olympics Program;
3. Evaluations and recommendations of present activities included in the current Special Olympic Program.

Each of the 50 state directors were asked to supply the names of 8-10 communities in their state they feel have a successful Special Olympics Program and 8-10 communities they feel do not have a successful Special Olympics Program.

On the basis of these findings, an experimental program was conducted with a State School during the second year of the project. Emphasis was placed on developing and testing training methods which would enable those individuals now excluded from programs to participate.

FINDINGS TO DATE: This project was completed in the fall of 1977, and the final report delivered to the funding agency, the Joseph P. Kennedy Jr., Foundation, in January 1978. The study showed positive effects of participation on the physical fitness and performance of the children, and positive attitude and expectancy shifts among parents and teachers of the children. Positive effects were also seen in the participating children's attitudes toward school and sports. Additional areas of study included a survey of the 50 state directors and over 300 area coordinators of Special Olympics programs in order to define variables which help account for successful programs. Included in this questionnaire were items dealing with background and training, number of hours per week spent on organizational activities, methods of recruiting and utilizing volunteers, sources and management of funding, and knowledge about and utilization of available resources. Several factors were isolated which discriminate between successful and less successful programs. Based on the survey data and data from other parts of the study, recommendations are made for further research or program or policy changes.

APPLICABILITY: One of the primary objectives of this investigation is to isolate factors which contribute to successful Special Olympics Programs so that all existing and future programs may benefit in terms of participant training and program administration. Since the foundation responsible for the initiation and continued support of the Special Olympics Program has funded this investigation, it is clear that there is an interest in program development which can readily lead to changes or recommended changes in practice if indicated by this research. It is hoped that recommendations stemming from this study will not be limited to Special Olympics Program changes, however, but will lead to a more global improvement in physical education programming for retarded individuals.

229 Extending Rehabilitation Services to the Multiply Handicapped

Principal Investigator:	**Andrew S. Martin, Ph.D.**	
Status:	**Completed**	
Dates:	**July 1974-December 1977**	
Cost:	**Annual $65,342** **RT Annual ***	**Projected Total $174,118** **RT % of Annual Total ***
Annual Report Reference:	**#7, Page 14, R-26**	

***No fiscal data are reported for completed projects.**

OBJECTIVES:

1. Develop procedures to utilize task analysis and learning principles to evaluate the needs of severely retarded clients for entry into sheltered workshops.
2. Design and implement individual training programs for vocational behavior prerequisites, work task performance, and work-related behaviors.
3. Train workshop personnel in methods of task analysis, evaluating training needs, and designing training programs.

METHODOLOGY: Initial efforts centered on conducting evaluations of strengths and weaknesses of sheltered workshop/work activities center dropouts, that is, lower level students who had failed for various reasons to adjust successfully to a workshop regimen. Task analyses were performed on subcontracted jobs which were already being performed by workers in the sheltered workshop. The task analysis and pursuant evaluation/training of clients provided data concerning task acquisition and problems encountered in the areas of motor, discrimination, and sequencing skills required of the subcontracted jobs. Task analyses of jobs were redone and learning principles were further analyzed for applicability when training data indicated a lack of effectiveness for given training strategies. Thus, a refining process was developed, whereby strategies were constantly evaluated in light of their effectiveness.

Task analysis and application of learning principles were also utilized to identify and ameliorate behavioral deficits in the work adjustment area. In training productive, adjusted workers, modifications of the physical training environment and feedback systems were designed to eliminate maladaptive behaviors and build responses necessary for work adjustment which were not in the behavioral repertoire of clients. Training programs, drawing on successive approximation and cue fading, for example, provided environmental features which were used to reduce various off-task and disruptive behaviors.

FINDINGS TO DATE: One series of studies was conducted to determine behavioral prerequisites for performing workshop jobs, the training required for severely retarded clients to acquire work skills, and effective strategies for training difficult operations in workshop jobs. In one study two procedures were compared for training time, production rate, and transfer savings. Results show that training time, errors, and production were near equal for a hand method vs. a foot-hand method for inserting staples in packages. The demonstration goal was met in this study in showing that severely retarded workers can be trained to do more than the simplest hand assembly work and that training time is no longer for the more complex method requiring eye-hand-foot coordination than for simpler methods. In another study, analysis of training data revealed that different error rates occurred for steps in assembling an eight-piece ball point pen, that errors were very high in early sessions, and then plateaued at about 15% for several sessions, with a sudden drop to criterion on acquisition. In addition, on post-criterion trials, few errors occurred, indicating that a criterion of ten consecutive errorless assemblies was adequate.

A second group of studies addressed problems of work adjustment of the severely retarded. Redesigned work stations, an off-task signaling system, small incremental time increases, and a monetary reward system were used in a training program to develop the work tolerance of severely retarded clients who had been released from a sheltered workshop because of extremely short "attention span," disruptive behavior, and low production. Results show that in as little as 27 days of training, one hour per day, mean time-on-task increased from 60% during baseline to 97%. Similar techniques were successful in training self-initiation of cycles in a repetitive task, as seen in increases in number of self-initiated cycles.

Factors underlying a work ethic with the severely retarded were also investigated in this project. Clients performed a work task for pay, charted earnings daily, and were taken on a weekly field trip to spend their earnings or saved toward future purchases. Under the field trip condition, production increased 41% over baseline, and saving for goals resulted in a 65% increase compared to production rates in a baseline condition. Studies are continuing in order to develop additional strategies for training work skills and work adjustment in the severely retarded. (See Project R-38).

APPLICABILITY: While recent legislation has mandated that the full range of rehabilitation services be extended to severely handicapped persons, including severely and profoundly retarded persons, this mandate is meaningless unless the technology exists and is available to practitioners who make these services possible. Until recently, the technology simply has not existed to make services available to the severely mentally retarded because practitioners were not able to teach or train these clients using the same techniques which are at best partially successful with higher level clients.

The goals of this project are to bring together results of other research, augmented by studies of our own, in order to develop and define a set of strategies for evaluating training needs of the severely retarded and an organized technology of training retarded persons. Only with a technology developed with and for retarded persons can rehabilitation practitioners begin to offer the type of services which can habilitate this group of clients.

230 Technology Assessment: Human Rehabilitation Techniques

Principal Investigator:	**Mohammed Ayoub, Ph.D.**	
Status:	**Completed**	
Dates:	**May 1975-January 1978**	
Cost:	**Annual $131,200** **RT Annual $1,800***	**Projected Total $262,400** **RT % of Annual Total 1%**
Annual Report Reference:	**# 7, Page 98, R-29**	

***These are FY 1977 figures—no fiscal data are reported for completed projects.**

OBJECTIVES: The overall objective is to systematically assess the potential consequences of alternative programs and emphases in rehabilitation so that the problem of disability itself is clarified and so that the implications of various efforts on behalf of the disabled are considered in advance of program implementation.

More specifically, the objectives of the technology assessment project are:

1. To specify variables in society which are related to rehabilitation and which may affect or be affected by changes in rehabilitation;
2. To analyze the problem of disability in the United States, based on existing information about prevalence, etiology, needs or impairments, costs to the nation, and so on;
3. To describe the state of the art in rehabilitation, indicating what current and emerging technologies constitute potential solutions to the problems of the disabled;
4. To systematically assess the short-term and long-term consequences of selected rehabilitation program thrusts or alternatives;
5. To provide decision-makers, policy-formulators, rehabilitators, and the general public with recommendations and objective analyses of the policy implications of alternative rehabilitation programs.

METHODOLOGY: A conceptual model developed for the study describes the needs of the disabled in terms of the following five life functions: mobility; health; communication; cognitive-intellectual function-

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ing; social-attitudinal functioning. The assumptions are that disabled persons fall short of normal functioning in one or more of the life functions, and that assessment of functional impairments is the most fruitful way in which to characterize the needs of the disabled for rehabilitation.

The conceptual model also specifies four types of rehabilitation technologies or approaches to the problem of disability: physical intervention; training/counseling; environmental change; change in service delivery.

With the conceptual model as a framework for analysis, the study was conducted through a combination of literature review, survey, consultation with experts, and committee work.

Based on such considerations as prevalence and severity of handicap, the following disabilities were selected for intensive case study: (1) rheumatoid arthritis, (2) coronary heart diseases, (3) emphysema, (4) cancer of the colon/rectum, (5) kidney diseases, (6) diabetes mellitus, (7) schizophrenia, (8) mental retardation, (9) epilepsy, (10) paralysis or loss of motor control associated with cerebral palsy, stroke, or traumatic spinal cord injury, (11) visual impairment or blindness, and (12) hearing impairment or deafness. Fourteen case studies will be undertaken, including separate studies for the three causes of paralysis. Each case study disability is described in terms of: (1) definition(s), (2) prevalence and incidence, (3) demographic distribution, (4) etiology, (5) impairments with respect to life functions, (6) implications for functioning as a member of the labor force and member of the community, (7) current technologies applied to the group, and (8) current service delivery organizations and functions.

Rehabilitation technologies are being analyzed in order to identify major technological alternatives and to describe their costs and benefits. Analytical papers have been prepared on broad topics such as housing, transportation, education, and income supplementation.

Resulting information on the societal context of rehabilitation, the problems of disability, and the state of the art in rehabilitation was prepared for use by working committees which will assess the consequences of alternative programs. A limited number of major groupings of technologies or coherent programs were chosen for assessment. The working committees were composed of social scientists, specialists in rehabilitation fields, and disabled persons representing respectively the voices of analysts of society, rehabilitators, and consumers of rehabilitation. Using a structured technology assessment procedure, four working committees—one for each of the four types of rehabilitation technology—considered the consequences for disabled as well as non-disabled persons of implementing alternative programs on a large scale.

FINDINGS TO DATE: During the fall of 1975, work began on the 14 disability case study papers. Results of the preparation of these papers revealed that the definitions of disability are unstandardized, unoperationalized, and generally unindicative of functional needs. Partly because of the diversity of definitions, estimates of the prevalence of various disabilities vary widely.

The analysis of technologies applied to the rehabilitation of the disabled revealed that there is a real need for some sort of centralized information exchange concerned with rehabilitation technologies. Technological development goes on in many cases in isolation from the mainstream of rehabilitation activities, and little or no technology literature bears on the development of technology based on needs assessments.

The reports on the case study disabilities have been completed, and the data from these reports has been analyzed and summarized in the report, **Scope of the Problem of Disability: Life Functions.** This report offers conceptual schemes for analyzing the scope of the problem of disability and provides data and analysis on definitions of disability, prevalence rates, demographics, etiology, life function needs, and status in the labor force and community.

All project materials, including the results of the work sessions and a set of policy issues and recommendations, have been synthesized in a final report volume accompanied by five more detailed volumes of material. The National Science Foundation is currently reviewing the final project report before it is disseminated more widely.

APPLICABILITY: The findings of the technology assessment of human rehabilitation will do much to: (1) integrate information about various disability groups served by RSA, (2) identify need commonalities and priorities, and (3) serve as a guide in the formulation of rehabilitation policy. The conceptual model for the project offers a means of examining, regardless of disability label, functional needs which can be met with rehabilitation techniques. The analysis of impacts on society of various rehabilitation efforts should provide a useful base of information for policy makers by identifying iterrelationships between rehabilitation and other societal systems.

231 State Agency Rehabilitation Counselor Functions and the Mentally Retarded

Principal Investigator:	**J. D. Parham, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1976-January 1978**	
Cost:	**Annual $24,246*** **RT Annual $15,643***	**Projected Total $23,465** **RT % of Annual Total 64%**
Annual Report Reference:	**# 7, Page 110, R-33**	

***These are FY 1977 figures—no fiscal data are reported for completed projects.**

OBJECTIVES:

1. To gather basic data on the functions typically performed by state agency rehabilitation counselors working with mentally retarded persons, specifying what tasks are performed and the proportion of time devoted to different tasks and task categories.
2. To make comparisons between general caseload counselors and counselors working primarily with the retarded with regard to the types of data specified above.
3. To make comparisons among mental retardation specialist counselors from the different state agencies in Region VI with regard to the types of data specified above.
4. To prepare an annotated bibliography of literature pertaining to the functions of counselors working with mentally retarded persons.

METHODOLOGY: Wright and Fraser's (1975) "Rehabilitation Task Performance Evaluation Scale" was selected for use in this study and was revised and expanded. This inventory will provide detailed information regarding which tasks rehabilitation counselors perform, the amount of time they devote to different tasks and task categories, and their perceived training needs for performing different tasks. Cooperation is being solicited from the directors of the seven state rehabilitation agencies in Region VI, with the aim of obtaining two samples of counselors (one of general caseload counselors and one of mental retardation specialist counselors) from each agency. When the samples are established, copies of the inventory will be sent to the selected counselors. State agency directors are being requested to set aside three hours of uninterrupted time during May, 1977 for counselors to complete the inventory. Counselors will return the inventory by mail to the Research and Training Center, at which time the data will be analyzed and interpreted.

FINDINGS TO DATE: Questionnaires were mailed to 260 general, mixed and MR counselors working in state agencies within Region VI. One hundred-sixty-two completed questionnaires were returned, providing a return rate of 70.4%. Analysis of the data was accomplished by analysis of variance and product moment correlation procedures. In general, little statistical difference was found between the three counselor groups regarding how they spent their time performing various functions of their job. One possible explanation for the lack of difference between general, mixed and MR counselors is that MR counselors may be distinctive in specific strategies used rather than time invested in a particular function. That is, while all counselors spent approximately the same amount of time performing the various functions, the manner in which they go about performing these functions may be greatly affected by the characteristics of the individual client. This study did not attempt to measure qualitative differences and was looking at quantitative aspects of the counselors functions only. Nevertheless, there was a surprising lack of statistical difference between counselor functions based on percentage of MR clients in the caseload, and even those few differences that did surface appeared to be of little practical or applied significance. It would appear safe to conclude that counselors in state agencies of vocational rehabilitation spend approximately the same amount of time performing similar functions regardless of the number of mentally retarded persons in their caseload and that, if differences exist, they are more likely to be qualitative than quantitative.

APPLICABILITY: The findings of this project have potential use for all individuals who work with retarded persons. They should be particularly helpful to state agency counselors in evaluating and improving their performance with mentally retarded clients and to state rehabilitation administrators in selecting, preparing, and utilizing rehabilitation personnel for work with retarded persons. The findings of this study can also be incorporated into undergraduate and graduate rehabilitation programs and into continuing education and in-service training.

232 Effects of Competition and Social Facilitation on Job Performance of the Mentally Retarded

Principal Investigator:	**Jerry L. Morris, M.A.**	
Status:	**Completed**	
Dates:	**June 1977-December 1977**	
Cost:	**Annual $2,500** **RT Annual $2,000**	**Projected Total $2,500** **RT % of Annual Total 80%**
Annual Report Reference:	**# 7, Page 41, R-35**	

OBJECTIVES: The present study measured the effects of competition and social facilitation on the motor performance of mildly and moderately mentally retarded persons and nonretarded persons of the same chronological age. The author is not aware of any studies which have compared the effects of competition and social facilitation on the same task with retarded and nonretarded individuals. It is not known if the retarded and the nonretarded react in the same way to these situational variables. Competitive or rivalrous behavior and changes in performance due to the expectation of evaluation and its possible consequences may be related to intellectual development. This study was an attempt to gain some understanding of the effects of competition and social facilitation on the motor performance of the mentally retarded and to ascertain whether these variables affect retarded and nonretarded individuals in the same way. The study measured the effects of competition, co-action, and the presence of an audience on performance on the Dots subtest of the Factored Aptitude Series. The dependent measures of performance were quantity of performance and quality or accuracy of performance.

METHODOLOGY: Forty-eight mildly and moderately retarded students of the Lubbock State School participated in the study. The mean chronological age (CA) was 21.2 years (range 16-27 years) and the mean IQ was 54.5 (range 41-70). Half of the participants were male and half were female. Racial group membership, socio-economic level, and etiology of retardation were randomly distributed in the sample.

The CA-matched nonretarded participants were 24 male and 24 female volunteers from undergraduate psychology classes at Texas Tech University. The mean chronological age of the university students was 19.95 years (range 17-26 years).

The dependent variables in the study were scores derived from 60 second performance on the Dots subtest of the Factored Aptitude Series. This task was selected because simple motor responses are most sensitive to social stimulation (Zajonc, 1969). The task requires the participant to put a dot in a series of small triangles without touching the sides of the triangle. A red ink marker with a fine nylon point was used to dot the triangles.

The experimental design for the study was a 2x3 factorial design with two audience conditions (audience present and no audience) and three types of work place organization (competition, co-action, and alone). The experimental design was identical for retarded and normal participants. Eight participants were randomly assigned to each of the six experimental conditions, with the restriction that there be four males and four females in each condition. All participants were given one practice trial on the Dots test to insure that they understood the instructions. The test was administered with the participants seated at a rectangular table.

In the Competition and Co-action conditions, three participants sat at each side of the table and one participant sat at each end of the table. Males and females were alternated in seating and were separated by approximately 47 cm.

In the Competitive conditions, the participants were told to race to see who could complete the most of the test correctly in one minute. It was stressed that they should compete with each other.

The participants in the Co-acting conditions were instructed to complete as much of the test correctly in 1 minute as they could. They were told that they should not be concerned with the performance of the other group members.

The participants in the Alone conditions were simply told to complete as much of the test correctly as they could in the time alloted.

For the Audience present conditions, the participants performed in view of one male and one female staff member of the Research and Training Center in Mental Retardation. An audience member stood approximately 4 feet from each end of the table where they observed and made written notes on the performance of the participants. Research has shown that an evaluative authority audience is more facilitating than either peer or non-evaluative authority audiences (Cohen & Davis, 1973). For this reason, the two observers were introduced to the participants as authority figures who were going to evaluate their performance. The introductions in this respect were slightly different for the normal and retarded groups. The normal participants were told that the audience members were very interested in and had conducted considerable amounts of research on motor dexterity and that they were going to observe and make notes on how well subjects performed on the test. The mentally retarded participants were told that the audience members were from Texas Tech University and that they were very interested in seeing how well the participants performed on the test. Also, they were told that the audience members would be watching them and making notes.

FINDINGS TO DATE: Of the experimental treatments in the present study, only competition had a significant effect on the quantity of motor performance by the moderately mentally retarded participants. There were no significant effects on quality of motor performance by the mentally retarded participants. Conversely, the effects of the treatments on the performance of the nonretarded participants were much in agreement with predictions made by Cottrell's revision of Zajonc's theory of social facilitation.

There are several possible explanations for these findings. Perhaps the mentally retarded participants did not perceive the audience members to be evaluative. The audience members could easily have been perceived as evaluative or of authority status by the college students. The fact that the audience members were introduced as being from Texas Tech University may have been meaningless to the mentally retarded participants. It may be that persons of authority at the state school for the mentally retarded would better constitute an evaluative, authority audience for the mentally retarded participants.

This study demonstrated that mentally retarded persons are sensitive to competition. Interestingly, they were not affected in exactly the same way as the normal sample. Like the normals, the mentally retarded competitors were faster than those performing alone. However, the quality of performance by the mentally retarded participants was not affected by competition. It was only the normal competitors who worked faster but produced work of lower quality than those working alone—confirming the findings of previous studies with normals.

The nonsignificant effects of an audience on the behavior of the mentally retarded sample do not warrant a conclusion that audiences have no effect on their behavior. A larger or different type of audience may well affect work quantity and quality.

APPLICABILITY: Application of the findings from this project could prove highly beneficial to sheltered workshop clients and supervisors. Empirically determined procedures for facilitating performance of retarded individuals in classrooms and work environments contribute to the rehabilitation process. In this study, the potential value of putting workers in competition with one another was suggested.

233 Group Homes for the Mentally Retarded in the Rehabilitation Process

Principal Investigator:	**Carol K. Sigelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1973-January 1978**	
Cost:	**Annual $13,745** **RT Annual $10,810**	**Projected Total $80,500** **RT % of Annual Total 79%**
Annual Report Reference:	**#7, Page 261, R-14**	

OBJECTIVES: The project is a comprehensive inquiry into the nature and effectiveness of group homes for the mentally retarded as environments for personal and social growth essential to vocational success. The research focuses upon three interlocking organisms: the mentally retarded person, the group home as a social system, and the community. Its objectives are (1) to determine critical differences between the institution and the group home as environments for developing social adjustment skills; (2) to determine the interrelationships between group homes and the communities in which they exist, focusing upon integration of the retarded into community life and responses of the community toward group homes and their residents; (3) to identify critical social adjustment problems encountered in group home placements, with an eye toward developing personal-social adjustment training programs designed to correct problems so identified; (4) to assess the effects of group home placement upon retarded clients with respect to personal, social, and vocational adjustment; and (5) to relate changes in group home residents to variables in the group home and its community. The study is, in general, designed to further knowledge of the support system and training strategies conducive to optimal social and vocational adjustment.

METHODOLOGY: Institutions, halfway houses, and small group homes have been compared through use of a scale of normalization developed and administered to houseparents and residential supervisors, and observational studies were conducted to compare actual activity patterns and supervision styles in small group homes and larger, institutional settings. Interrelationships between group homes and their community settings were assessed through use of a group home survey and an indirect attitude questionnaire designed to measure attitudes in the Lubbock, Texas community. A long-range goal of improving personal-social adjustment training in transitional facilities was approached through a multiple step process to culminate in the development of guidelines and recommendations for adjustment training. Where Facility logbooks and behavior rating forms were the primary data sources. Where agreements with operating facilities could be made, a checklist of Skills and Knowledge Important for Community Adjustment was administered to houseparents at six-month intervals for each resident in the facility, supplemented by observation where possible.

FINDINGS TO DATE: A group home survey was completed by almost 50 facilities to yield basic descriptive information. Further information has been collected on each of the major study areas. There were not significant differences with respect to normalization between facilities for the retarded and facilities for the non-retarded. However, analysis of facilities for the mentally retarded indicated that as the number of residents increases, normalization decreases.

Two observational studies have been conducted. The results of one study indicated that leisure behaviors in two group homes were very similar but differed systematically from leisure behaviors in an institutional cottage. The study also indicated that the group homes were characterized by more balance among activity types, particularly by a reduction in the amount of passive leisure and an increase in the amount of household performance. However, the group homes did not seem to be encouraging the kind of goal-oriented, creative leisure which would help the retarded to adjust to independent living. The single most important finding to emerge from the second study was that residential environments differ from one another in complex ways. The study did not uncover differences in staff-resident interaction patterns which would discriminate reliably between group homes and larger, institutional settings.

A study of community attitudes relevant to community placement of retarded adults conducted in Lubbock, Texas, suggested that Lubbock residents lack well-formulated opinions for or against group homes, but are generally somewhat unfavorable. Demographic variables did not go far in predicting which types of people are most receptive to group homes and legal rights for the retarded.

Staff logbooks have been used as a source of data concerning adjustment problems in four facilities of the halfway house design. Individual problem behavior tends to be consistent over time, and often centered on failures of responsibility. However, individual problem behavior could not be readily predicted on the basis of IQ, adaptive behavior, or sex.

A study of personal-social functioning with implications for adjustment in the community developed a method of assessing the job interview skills of the mentally retarded client. Nonverbal behaviors, verbal behaviors, and measured intelligence predicted the favorability of ratings given to interviewees by personnel interviewers.

Analysis of results of studies to establish the utility of the Skills and Knowledge checklist suggested that checklist performance is highly related to IQ score. The checklist discriminated among clients at different levels in a deinstitutionalization program. Reliability was judged minimally adequate.

Analysis of changes in checklist scores for institutionalized and group home samples indicated that institution residents exposed to a community living skills tutoring program improved over a 6-month period as much as group home residents but more than residents of another institution without such a tutoring program. Analyses using data from project R-21 in Texas are continuing.

APPLICABILITY: Better understanding of the nature and effectiveness of group homes will be immediately useful to vocational rehabilitation agencies currently using or planning to use group homes as a rehabilitative tool. In addition, analysis of social adjustment problems of retarded residents in group homes will expedite analysis of similar problems in other settings. Finally, the study is designed to uncover the types of environmental intervention which produce positive change in personal and social attitudes and behaviors relevant to employability and vocational success.

234 Factors Underlying Successful Adjustment of the Retarded Released from Institutions

Principal Investigator:	**Nancy J. Bell, Ph.D.**	
Status:	**Continuing**	
Dates:	**July 1973-July 1978**	
Cost:	**Annual $13,512** **RT Annual $9,545**	**Projected Total $195,000** **RT % of Annual Total 71%**
Annual Report Reference:	**#7, Page 281, R-21**	

OBJECTIVES:

1. To assess changes in the characteristics of the retarded individuals who are furloughed and discharged from residential facilities during an eight-year period.
2. To study the relationship between individual characteristics of the retarded persons and the critical behaviors they exhibit which result in success or failure in community adjustment.
3. To evaluate the role of various supportive services which are important in maintaining retarded persons in the community.
4. To study the quality of the personal, social, and vocational life of retarded persons who have been furloughed or discharged from state residential facilities.
5. To compare the procedures and operational philosophies regarding furlough and discharge of residents in eleven residential facilities.
6. To assist not only the Texas Department of Mental Health and Mental Retardation, but agencies throughout the country, in developing more effective plans for selecting and training retarded individuals for community placement and for developing community services.

METHODOLOGY: The first stage of this project involved mailing questionnaires to a sample of 500 former residents of Texas state schools for the retarded who were discharged from 1968-1973. Various topics relating to community adjustment were addressed in these questionnaires. Background data on each subject was provided by the institutions. Personal interviews were conducted with a sub-sample of both those who responded and those who did not return the mail questionnaire. Stage One of the study was designed to permit comparison of those discharged in past years with those furloughed from institutions in 1974 in Stage Two. Stage Two of the study involved a longitudinal follow-up of those individuals furloughed for at least 90 days from any of the Texas state schools during 1974. These people were contacted shortly after separation from the institution and then periodically thereafter for approximately 2-1/2 years. Individuals from all age and ability levels were included in the sample. At each community contact, information was obtained from a personal interview with the client, a guardian or houseparent interview, and observations made by the interviewer about the client's behavior and environment. Guardians or houseparents were also asked to complete an adaptive behavior rating form. This rating, along with ratings of work skills, were also provided by state school personnel at the time of a subject's furlough. Upon a client's return to the institution, guardians and state school personnel were asked to provide information about reasons for return and problems encountered in the community. Information was obtained for all subjects in the form of background and psychometric data from institution records. In order to compare community lifestyles and problems of previously institutionalized retarded persons with those of nonretarded community residents, a short form of the client interview was administered to 151 residents of Lubbock, Texas, who were similar to the retarded sample in age, sex, and ethnic characteristics.

FINDINGS TO DATE: **Mail Survey.** Based upon information obtained from approximately 39% of the sample, there were lifestyle differences between ability groups (IQ below 55 and IQ 55 or above) on most variables examined. The lower ability group was living a more sheltered life and appeared to be more dependent upon others than the high ability group. Examining adaptive behavior scores in relation to employment suggested that some minimal level of skills may be important, but beyond this minimum level, increasingly higher scores did not differentiate the unemployed from those employed. Thus, while it might be possible to develop predictive estimates of the likelihood of employment and degree of independent living based upon IQ and adaptive behavior scores, this prediction would not be very precise. The most important difference between high and low ability individuals may involve a variety of community support factors. These environmental factors include kind of training received while in the institution and agency assistance in the community. Those with IQ's above 55 received more training and agency support than did the lower ability group, which may in itself be a primary reason for community lifestyle differences. In comparing leisure activities of retarded persons with the non-retarded, the respondents were divided into three major groups for analysis: moderately retarded (IQ below 55), mildly retarded (IQ 55 and above), and community sample. Types of leisure activities were categorized as community interaction (attendance at movies, restaurants, clubs, etc.) or social activities (contact with friends, dating, etc.). In community interaction activities, the mildly retarded did not differ from the community sample. In the areas of social activities, however, participation of the community sample exceeded that of the mildly retarded group, which in turn exceeded that of the moderately retarded. Differences between the groups in socio-economic and marital status are possible explanations, as are IQ-related differences in social knowledge and skills, differences in opportunities to meet people and possible constraints placed on social life by living at home with parents. Personal evaluation of lifestyle was measured by responses to items asking which things were problems from the respondent's point of view. A greater number of the retarded than of the community group reported problems finding friends (same and opposite sex) and problems figuring out what to do with their time. **Longitudinal Follow-Up.** Data collection was completed in June, 1976. A total of 582 individuals were included in the sample. The final current status on each client was established as of October 31, 1976, three years after the first furlough reports were received. As of that date, 55% had received discharges from the institutions, 32% were still on furlough status, 12% had returned and were residents of the institutions, and 1% were decreased. Analysis of differences between those who remained in the community versus those who returned to the institution at any point has revealed that the returnees were likely to be older (over 30); placed in group homes or with employers; and placed near state schools. Returnees also tended to have less income and less involvement in social relationships and activities. Interestingly, lower IQ clients were no more likely to return than higher IQ clients. Major analyses of the longitudinal data currently underway are designed to clarify: (1) what the status and experiences of clients are at different time periods after furlough; (2) what variables change significantly over time; and (3) what variables predict adjustment at various times.

APPLICABILITY: This study will provide general feedback on the current status of clients who have been institution residents and permit comparisons of those discharged in the past with those currently being placed in community settings. The identification of particular areas of difficulty shortly after separation from the institution can provide the basis for expanding or altering emphasis in existing pre-release training programs. Similarly, difficulties occurring later after separation may suggest the need for certain types of community support programs. There are potential long-range implications of this information for selecting and placing residents. This study, perhaps in combination with the results of other recent studies of the same type, may permit fairly good prediction of which individuals will do well in community placement at a given point in time and thus are ready for separation, as opposed to those who would benefit from additional training. Also, it may aid in identifying important determinants of the type of placement most suitable for a given individual. It is hoped that the findings will aid both institutions and community agencies in deinstitutionalization efforts and in providing appropriate supportive services.

235 Process and Outcome in Cooperative School Programs in Texas

Principal Investigator:	**Carol Sigelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1976-December 1978**	
Cost:	**Annual $19,015**	**Projected Total $38,030**
	RT Annual $14,720	**RT % of Annual Total 77%**
Annual Report Reference:	**# 7, Page 127, R-30**	

OBJECTIVES: The objectives of this study are: (1) to describe process variables in cooperative school programs (CSPs) in Texas, identifying components of programs which vary from school to school and from client to client; (2) to measure outcomes of cooperative school programs in terms of the client's level of social and vocational information, vocational status at the end of the twelfth grade, and rated adjustment in a vocational placement; and (3) to identify relationships between process and outcome variables which would indicate that certain program offerings and experiences contribute to client success.

METHODOLOGY: This study represents an attempt to determine which program factors contribute to the effectiveness of cooperative school programs. Its basic design included the following:

1. **Sample Selection:** A list of graduating seniors and a list of their primary disability was obtained from each cooperative school program. To limit the number of programs from which students were sampled and to represent proportionately program variables of possible importance, it was decided to classify the graduate lists on the basis of four relevant variables. Proportionate numbers from each classification were selected to equally represent the distribution of variables in the population of graduates.
2. **Background Variables:** Data collected consisted primarily of that which was readily available in the VAC's student/client files or on the rehabilitation agency's central computer file (e.g. ethnic group, secondary handicaps, available standardized achievement test score, number of years in special education placement, number of family members.
3. **Process Variables:** The key personnel in the cooperative school program — the Vocational Adjustment Coordinator, Director of Special Education (DIR), the Vocational Rehabilitation Counselor (VRC), and the Rehabilitation Supervisor (SUP) — were asked to complete a questionnaire about program characteristics, operation, and offerings. The VAC and VRC also completed another questionnaire pertaining to each individual student in the study. Questionnaires completed for each subject in the study were designed to reveal individual differences in experiences within the context of a general program.
4. **Outcome Variables:** Outcome measures, collected just prior to graduation, consisted of the following: (1) the **Social and Prevocational Information Battery,** (2) information obtained from vocational rehabilitation case files and from VACs and VRCs concerning income, type and length of job placements, and judgments about current work adjustment and prognosis. (3) **The Worker Rating Form,** developed by the Texas R&T Center, and completed by student's employer or work supervisor.

FINDINGS TO DATE: Analysis of open-ended questions concerning the greatest strength in CSPs revealed that a substantial portion of the respondents (30%) felt that smooth and open communication among CSP personnel, regular school staff, administrators and the community was the greatest strength of their CSPs. The next most mentioned strength was VAC competence. Regarding weaknesses, communication again was the most frequently mentioned area, but it was perceived only about half as many times as a program deficit than as a strength. Fifteen percent of the respondents perceived a shortage of on-campus training opportunities as the greatest weakness.

The VAC, VRC, and DIR responded to a rating form asking them to determine whether the performance of various staff roles, including those in special education and rehabilitation, was below, at, or above expectations. While the VRCs rated nearly half of the VACs as performing above expectations, vocational education and regular teacher roles were frequently perceived as below expectations. VAC and DIR ratings of the staff roles were similar to those of the VRC in terms of percentages of roles perceived as being performed below, at, and above expectations.

In order to identify factors which facilitate or inhibit the effectiveness of the CSP, all responding groups completed a Likert-type scale consisting of items related to program success. Each respondent rated each factor as it related to their CSP on a scale ranging from excellent to very poor. While the overall means for each item were high for all rating groups, two factors — curriculum availability and availability of jobs — emerged as relatively weak factors.

Correlations performed to assess the extent to which different participants in the same programs agreed in their perceptions of the factors in program effectiveness found a moderately high degree of agreement among CSP personnel.

Analysis of the individual items, however, indicated that intra-agency agreement was generally higher than interagency agreement. In comparing subgroups on favorability of item ratings, the SUP and DIR, persons who are more remote from the CSP, were generally more favorable in their ratings than were the VAC and VRC. Analysis is continuing.

Following are some highlights on findings on student variables.

1. Students in cooperative work-study programs were placed in a variety of jobs outside the traditional service occupations. (On the whole, students above IQ 84 and males were placed in mor diverse and complex jobs).
2. As for their salaries, the students started their final jobs at an average hourly wage of $2.32 per hour (range $.50-7.25). At the time of the study, a large proportion of the students (69%) were earning $2.30, the federal minimum wage, or more.
3. Employers were generally satisfied with workers from cooperative school programs, perceiving them as frequently or almost always engaging in appropriate behavior at work.

4. VACs ratings indicated that students generally had good attitudes when they first took their final jobs and that they had adjusted well to the jobs.
5. Overall, the Texas students were performing at about the 40th percentile in terms of their total SPIB scores.
6. VACs and employers share similar perceptions of the performance of students, even though they observe students in different settings that make different demands on students. At the same time, the VAC's assessment of a student is higher when the student shows mastery of the kinds of information tested in the Social and Prevocational Information Battery. While knowledge is not all that is needed for successful adjustment, our findings suggest that the kinds of knowledge assessed by the SPIB bear at least a modest relationship to other kinds of outcomes, including employer and VAC evaluations of students. Wages were only modestly related to other measures of outcome, but it is quite likely that a student's salary depends on many factors in the placement process and the job market that have little to do with client abilities.

APPLICABILITY: The idea for the proposed study originated with the Texas Rehabilitation Commission (TRC). Specifically, the program specialists in mental retardation voiced a desire for a study which would not only provide systematic information about the effectiveness of the cooperative school program, but also identify components of such programs which contribute to successful outcome. Because the Texas Rehabilitation Commission, the Texas Education Agency, and the R&T Center are full partners in conducting the study, its relevance and potentials for utilization are maximized. Because it appears that no studies focusing on relationships between process and outcome in cooperative school programs have been done elsewhere in the country, the present study will have potential relevance to program planning and design outside of Texas. Finally, this first attempt at a process-outcome analysis should have heuristic value, stimulating further studies aimed at improving the benefits derived from cooperative school programs for the mentally retarded.

236 A Study of Consumer Needs, Circumstances, and Attitudes

Principal Investigator:	**Carol K. Sigelman, Ph.D.**	
Status:	**Continuing**	
Dates:	**January 1977-December 1978**	
Cost:	**Annual $74,425** **RT Annual $58,075**	**Projected Total $100,000** **RT % of Annual Total 79%**
Annual Report Reference:	**7, Page 299, R-34**	

OBJECTIVES: The President's Committee on Mental Retardation commissioned this study with the main objective of determining whether a national consumer sampling approach is a feasible way of quickly determining the needs and attitudes of the retarded in such a way that national policy could be formulated based on the information received. The feasibility of such an approach will be determined by: (a) developing procedures which address problems of identifying and accessing a representative sample of retarded persons; (b) determining the most valid and reliable interviewing techniques to be used with a retarded population; (c) developing written guides and training procedures for interviewers; and (d) testing the adequacy of sampling and interviewing techniques used as a data base for policy-making. This study will also seek to meet PCMR's second objective of providing information on the needs, circumstances and attitudes of a sample of retarded persons with respect to: (a) the extent to which community services are available, known to, utilized, and positively received by the retarded consumer; (b) the nature and quality of his/her living circumstances; and (c) the extent to which he/she has the opportunity for decision-making in regard to his/her life circumstances.

METHODOLOGY: Review of previous prevalence estimation studies will be the primary methodology for constituting an ideal sample based on a matrix broken down by various demographic variables. In order to determine the feasibility of actually locating, gaining clearance for, and obtaining consent from subjects, major agencies will be polled by mail on their policies regarding release of information about clients. Also, during the interviewing of the retarded subjects, extensive records will be compiled on problems encountered and time spent with various techniques of accessing subjects. Content areas have been limited to: (a) availability, accessibility, need for, use of, knowledge of, and attitudes toward services for the retarded; (b) nature and quality of residence, income, and social life: and (c) opportunity for and experience in decision-making. Instruments to be developed include a background information form, and agency survey, a client interview

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form, a parent or "significant other" form, and an interviewer observation form. After clearance of these forms by the Washington offices of RSA, OHD, and OMB, a series of pilot studies will be completed to explore determinants of responsiveness, reliability and validity, as well as to guide the selection of questions for the final interview study. This series of pilot studies will result in a final questionnaire which optimizes responsiveness and reliability, as well as research reports which clarify several critical issues in the feasibility of interviewing mentally retarded persons.

FINDINGS TO DATE: A series of activities, involving input from PCMR and preliminary interviewing, culminated in the development of questionnaires to be used in assessing the feasibility of interviewing mentally retarded persons across the IQ range. Literature reviews are nearly completed of communication skills of the mentally retarded, response sets in interview research, and prevalence estimation; and research regulations have been studied through national mailings requesting information of a variety of agencies and organizations. Two interview studies, one of institutionalized children and one of institutionalized adults, have been conducted. In each case, 50-60 residents of different levels of mental retardation were interviewed with alternate forms of an interview schedule administered a week apart, and attendants at the institution provided answers to most of the same questions that clients answered. Preliminary analyses indicate a strong relationship between IQ and ability to respond appropriately to questions; a modest improvement in responsiveness from first to second administration; several difficulties at all levels of retardation involving inconsistencies among responses to alternate phrasings of questions on the same topic e.g., the operation of an acquiescent response set; and relationships of both responsiveness and consistency of response to the type of question format used (e.g., yes-no, either-or, open-ended). Data collection for a third study involving interviewing of retarded children in the community and their parents is currently underway.

APPLICABILITY: The study will provide an assessment of the needs of the severely retarded and the multiply handicapped, as well as information about how well agencies are meeting their needs and those of the entire range of mentally retarded persons. This is especially relevant due to the current emphasis on serving the severely handicapped and providing programs for them at the community level. In order to fulfill the spirit of consumerism in current legislation for the handicapped and to provide a mechanism for feedback, some assessment of the attitudes of the handicapped toward rehabilitation agencies needs to be made. This project will be designed so as to obtain information which should be readily used by service agencies in better understanding their clients and enabling them to better meet the clients' needs. Data will be collected which can be utilized by federal agencies in evaluating their present programs and in formulating national and agency policy.

237 Effects of Job Enrichment on Work Performance of the Mentally Retarded

Principal Investigator:	**Andrew S. Martin, Ph.D.**	
Status:	**New**	
Dates:	**June 1977-December 1978**	
Cost:	**Annual $27,998** **RT Annual $22,534**	**Projected Total $41,997** **RT % of Annual Total 80%**
Annual Report Reference:	**# 7, Page 53, R-36**	

OBJECTIVES: The overall objective of this project is to study the process of job enrichment and the effects of enriched jobs on the work behavior of retarded persons.

The specific questions under investigation are:

1. Does an enriched job provide more **intrinsic** motivation than a simplified job for retarded workers? More precisely, do retarded persons perform better (i.e., have higher output and fewer errors) in a job which contains more varied elements (horizontal loading) and more discretionary or decision elements (vertical loading) than they do in simplified low cycle time jobs?
2. Are any benefits which accrue from enriched jobs due to the enriched jobs themselves, or to the **process** of job enrichment?

METHODOLOGY: The proposed project will utilize a 2x2 factorial design with two levels of jobs (simplified vs. enriched) and two sequences of program implementation in an A-B: B-A design. Half of the subjects will start on the enriched job and change over later to the simplified job, while the other half of the subjects will start on a simplified job.

The jobs, both enriched and simplified, will involve assembly of an electronic circuit consisting of approximately 6-8 parts. This job will be created for this study, but will use commercially available parts and will approximate contract assembly work. The specific design of the job is not yet complete; however, it will have the following features: Clients will be brought into a training workshop established at the Lubbock State School by the Research and Training Center. They will be trained individually to perform one of the 6-8 component assembly tasks to a criterion of 8 out of 8 consecutive errorless trials. Following pretraining, clients will be introduced into the work situation, which will consist of individual work cubicles partitioned off from other workers to avoid confounding effects of competition and social stimulation (see proposed project, "Effects of Competition and Social Stimulation,"). Clients will work at the job for which they were trained for approximately 6-8 weeks to establish stable work patterns and to provide sufficient production and error data for analysis. Clients working on the enriched job will follow the same procedure except that they will be trained to assemble and test the entire unit. There will be a training period prior to the changeover to a new job.

Client pay. All clients will be paid hourly wages based on percent of "normal" output during the production portion of the study. Clients will be paid a flat rate during training, with all clients receiving the same amount. It is felt that the above procedure will eliminate bias due to differential pay scales for different jobs.

Data analysis. Data (production and error) from the simplified and enriched jobs will be analyzed by statistical tests appropriate to the variables (independent variables: order effect and type of job; dependent variables: production rate and error data). Additional data on training time (trials and days to criterion) will be recorded to permit analysis of covariance with final production data. Finally, trends in rate and errors over time will be examined to determine if enriched and/or simplified tasks result in stable performance or only produce a novelty effect which wears off over time.

Later studies will investigate effects of jobs which vary in content but which provide no closure, or sense of product completion. This could be done in the present study; however, spance and client population limitations mitigate against grand designs. The present study should clarify effects of job enrichment for retarded clients and make design of subsequent studies more cost and information effective.

FINDINGS TO DATE: This is a new project, currently being conducted. No data are available yet.

APPLICABILITY: Past efforts at rehabilitation of retarded persons through work-vocational rehabilitation have been haphazard efforts to establish a work situation, or a "work like" atmosphere, in which it is hoped that something would happen to the retarded client to make him/her a better person. These efforts are not haphazard by design, but are, in most instances, extremely well intentioned efforts to help, in the absence of knowledge of how to help. The technology of vocational rehabilitation of retarded persons is still very embryonic, and many practitioners operate as much on truisms as on empirical evidence. Two of the truisms that are the basis for much sheltered work and contract procurement efforts are that the retarded (1) can't learn complex tasks, and (2) like, or at least tolerate well, dull, repetitive tasks. Much evidence is accumulating to refute the first point, and the personal observations of the author and many others in the field have been that not only do the retarded not **like** dull, repetitive tasks any more than their higher IQ counterparts, but that in fact they may tolerate them much less well than normal workers. The present study is designed to provide information about the ways in which job organization affects the work behavior of retarded workers. Outcomes of this study will provide much needed empirical evidence about the motivational structure of job situations, and the capabilities of retarded clients to acquire more complex jobs involving skill and judgment.

238 Development of a Taxonomy of Assembly Skills

Principal Investigator:	**Robert W. Flexer, Ph.D.**	
Status:	**New**	
Dates:	**September 1977-September 1978**	
Cost:	**Annual $18,969** **RT Annual $15,054**	**Projected Total $18,969** **RT % of Annual Total 79%**
Annual Report Reference:	**# 7, Page 62, R-37**	

OBJECTIVES:

1. To survey literature related to assembly skills to generate descriptions and a taxonomy of assembly skills.
2. To task analyze actual assembly jobs to test the completeness and applicability of the taxonomy.

METHODOLOGY: A first step would be a search of the literature on discrimination and motor learning, industrial engineering, and vocational training and evaluation to define and classify a compendum of motor, discriminations, and judgment skills of relevance to assembly tasks and to synthesize this information in a taxonomy.

The next step of the study will entail collection and task analysis of assembly tasks. From the skills identified in the literature search, assembly skills which are common and unique to each task will be classified. Sampling of assembly tasks will require on-site analysis of actual jobs.

FINDINGS TO DATE: Due to lack of funding for suitable support personnel, this project has not been initiated. It has been approved for initiation by peer reviewers, and it is hoped that appropriate personnel will become available so that project activity can begin.

APPLICABILITY: There are knowledge gaps in the rehabilitation field concerning the vocational potential of the mentally retarded. Although the types and levels of jobs available to the retarded are expanding due to an improved training technology, little is known about the content and sequences of instruction which will better prepare the retarded for employment.

In vocational programs, training in assembly skills is an important part of the instructional program. Many of the subcontracts procured by sheltered workshops are assembly tasks and potential competitive placement for many mentally retarded persons is with manufacturers who provide a variety of assembly jobs. This project will provide information about the assembly skills that are common to a variety of assembly tasks, thus providing content for vocational training programs.

239 Effects of Goal Setting Training on the Job Performance of the Mentally Retarded

Principal Investigator:	**Robert W. Flexer, Ph.D.**	
Status:	**New**	
Dates:	**June 1977-June 1980**	
Cost:	**Annual $55,053** **RT Annual $42,913**	**Projected Total $165,159** **RT % of Annual Total 78%**
Annual Report Reference:	**#7, Page 70, R-38**	

OBJECTIVES: Two major objectives will be addressed: to maintain productive behavior and to delay tangible or primary reinforcement over one week periods. Through fractionation of the long-range goals (dividing long-range goals into shorter intermediate goals) and reinforcement of the goal setting behaviors with feedback systems and further incentives such as bonuses, attempts will be made to shape sustained performance over one week periods. Finally, through a fading of reinforcement and fractionation of goals this study will investigate the possibility of maintaining productive behavior of clients in sheltered workshops while remaining on the usual one-week pay schedule.

METHODOLOGY: The basic question addressed in this programmatic research effort is: Do the setting and attainment of monetary goals spanning one week serve as an effective motivation for the mentally retarded? Two comparisons will be made to answer the question. Individual performance under goal setting conditions will be compared to a baseline condition in which payment for work will be on a piece-rate system (e.g. one penny for each assembled ball point pen). In addition to within subject controls, group performance under treatment will be compared to a control condition where feedback on earnings will be administered on a daily basis.

For the within subject assessment, clients will be placed under baseline conditions, work under conditions or goal setting, return to baseline, then return to goal setting. The same number of clients will undergo an ABAB design but only receive feedback on earnings. A between subject assessment will be made for the goal setting treatment clients and the control feedback clients for the B portions of the program. Ten clients will be administered each of the treatments.

The procedures to be used are:

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Baseline: Clients will be told that they will receive payment for the number of pens they assemble every Thursday, pay day for sheltered workshop clients. Baseline conditions will continue until clients have shown stable performance. The same condition will be readministered following the first treatment and control administrations.

Treatment: Clients will be assigned monetary goals to attain. The production rate under baseline conditions will be pro-rated over five days to obtain a total goal amount. Clients will work until they reach the goal. As soon as clients reach the goal amount, they will be assigned a new goal. Feedback will be administered daily to show progress toward the goal. Three goals will be assigned during the first treatment segment. A second treatment segment will be administered following reinstatement of baseline conditions.

Control: Control clients will be shown daily how much money they made and the money will be deposited in a bank to be paid at the end of the work week.

Subsequent studies will employ the same design, but under the second treatment phase in the ABAB design variations of technique for assigning goals and giving feedback about progress toward goals will be tested.

FINDINGS TO DATE: This project is an extension and refinement of some findings from project R-26. For preliminary results from which this project grew see project R-26.

APPLICABILITY: Previous studies by the authors have focused on whether severely retarded persons can delay gratification and work toward long-range goals. Types of goals have been varied, as has the length of time required to reach the goal. These studies have shown that the severely retarded can in fact work for longer range gratification. The present series of studies is designed to investigate different types of feedback systems for relaying information to clients about their progress toward a goal and to test the limits of these systems. These studies complement other work being done at the Texas Tech R&T Center, and other MR centers, in that they focus on maintenance of performance in a training and work setting. The importance of these studies for the rehabilitation of retarded persons rests on the generalizability of these systems to any work setting for the retarded, and their compatibility with different training systems. The studies in this proposal will investigate maintenance systems for keeping productivity at a high level. This maintenance is of prime importance since, as earlier studies have pointed out, severely retarded persons can be trained to produce quality products at competitive rates, but when they moved from a training setting into a sheltered workshop with no maintenance program, their performance deteriorated. Feedback systems of the type to be investigated in the present studies can be easily installed in work settings, or incoporated into job design, to help provide the necessary maintenance support to keep skills and behaviors acquired in training at a high level.

240 The Relationship Between Principals' Attitudes Toward the Retarded and Cooperative School Programs and Selected Program Factors

Principal Investigator:	**Thomas Smith, Ed.D.**	
Status:	**New**	
Dates:	**June 1977-December 1978**	
Cost:	**Annual $5,757** **RT Annual $2,875**	**Projected Total $8,635** **RT % of Annual Total 50%**
Annual Report Reference:	**# 7, Page 148, R-39**	

OBJECTIVES:

1. To determine the interrelationships among principals' attitudes toward the retarded, learning disabled, and normal person; principals' attitudes toward Cooperative School Programs, and vocational adjustment coordinators' (VACs) ratings of role performance of principals;
2. To determine the relationship between principal attitudinal variables and selected principal background variables;
3. To determine the relationship between principal attitudinal variables and VAC ratings of role performance of selected school staff and VAC ratings of program quality.

METHODOLOGY: This study is an exploratory survey of administrative variables which may be related to program variables of significance for successful operation of CSPs. A mail questionnaire was

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sent to 198 principals of schools with CSPs in the state of Texas, randomly selected from all the high schools in the state. Follow-up letters were mailed to respondents who did not answer at two and four weeks after the initial mailing.

There were three sets of questionnaires in the mailed packets:

1. Questions concerning background variables of interest, **Background Information Form (BIF)**
2. Questions concerning opinions about aspects of CSPs, **Program Attitude Scale (PAS)**
3. Semantic differential scales on the mentally retarded (MRATT), learning disabled (LDATT), and normal person (NPATT)

Data from R-30 were used to determine the relationships among the principal attitudinal data and variables related to program quality as perceived by VACs.

FINDINGS TO DATE: In order to study the relationships of interest, questionnaires on attitudes and background information were sent to the principals of the 98 schools participating in Project R-30 and an additional randomly selected 100 principals. A total of 129 respondents returned the questionnaires after two follow-up letters.

Ratings on 16 bipolar, 5-point adjective scales were obtained for the concepts of normal person, mentally retarded person, and learning disabled person. Tests of mean differences indicated that the semantic differential ratings of the mentally retarded person were less positive than those of the learning disabled ($t = 3.79$, 97 df, $p < .001$), and the normal person ($t = 9.74$ df, $p < .001$) and ratings of the learning disabled person were significantly less positive than those of the normal person ($t = 8.02$, 97 df, $p < .001$). Examination of the means showed that although the learning disabled person was perceived more favorably than the mentally retarded person, the mean for learning disabled is closer to the mentally retarded mean than to the normal mean.

Another indicator of administrative attitude which was collected for this study was a 16-item scale on attitudes toward aspects of CSPs. Item means indicated acceptance of the concept and basic operational procedures of cooperative school programs, but some controversy regarding diplomas, payment for on-campus work, serving severely handicapped youth, and the role of the vocational rehabilitation counselor.

VAC ratings of principal performance and principal attitude toward the learning disabled were highly and significantly related. Probably the most significant were the high and significant correlations found between the principals' program attitudes and attitude toward the handicapped groups predominantly served by CSPs. These findings suggest that administration support, a key to effective operation of CSPs, may require extensive in-service training focused on principals' relationships to CSP programs as well as their basic attitudes toward these students.

Background information on administrative and CSP experience and types of contact with the mentally retarded showed that amount of experience with the cooperative school program, both as a teacher and as a principal, was highly related to mean program attitude (for years as teacher $r = .36$, $p < .001$; for years as a principal $r = .32$, $p < .001$). Attitudes toward the retarded and teaching experience with the mentally retarded were positively related.

As a preliminary data analysis, the mean semantic differential ratings of the mentally retarded and the learning disabled person were correlated with the VRC ratings of each of 13 school staff roles and 15 factors of importance to CSP operation. The role ratings of the regular school counselor, the TRC counselor, and TRC supervisor were **negatively** correlated with the principals' attitude toward the retarded, suggesting that the persons in those roles may have performed beyond the call of duty in the face of principals who were not accepting of the mentally retarded students in the program.

Of the program factors rated by VACs, relationships between CSP and other school staff, cooperation from students' parents, availability of appropriate jobs, and supervision of students by employers were all significantly related to principals' attitudes, with only the first being a positive relationship. It appears again that with these factors, as with the staff role performances, a prejudiced principal in the school induces extra efforts and cooperation by others in the service of the CSP.

APPLICABILITY: In CSPs the total school environment is essential for the rehabilitation of retarded youth. The degree to which the members and departments of the school community work in unison to benefit the retarded can have much impact on the CSPs and their success in rehabilitating retarded youth. The principal as the leader in the school has great influence on whether other school staff cooperate with the efforts of the CSP staff. Understanding how the principal affects the operation and effectiveness of CSPs will aid in the education of persons in this vital administrative role and in outlining the structure of CSPs as they relate to the school community.

241 Vocational Handicapping Conditions as a Function of IQ

Principal Investigator:	**Gerard J. Bensberg, Ph.D.**	
Status:	**New**	
Dates:	**June 1977-May 1980**	
Cost:	**Annual $76,625** **RT Annual $40,147**	**Projected Total $120,000** **RT % of Annual Total 52%**
Annual Report Reference:	**# 7, Page 163, R-40**	

OBJECTIVES:

1. To identify and compare the needs and deficits of persons in the severe, moderate, mild, and borderline levels of intelligence in such areas as personality, adaptive behavior, sensory and motor functioning, vocational aptitudes, and work-related behaviors.
2. To describe the rehabilitation process for such persons in both rehabilitation and school settings and to examine how the process differs for clients of different intellectual levels.
3. To measure outcomes of rehabilitation services and determine relationships between outcome and (a) intellectual level, (b) functional levels, and (c) types of services received.

METHODOLOGY: In response to input from state rehabilitation agencies in the region, the study will focus on school populations as well as on clients referred to rehabilitation agencies from other sources. In Arkansas, data collection will center on a vocational evaluation unit which serves the entire state; in Texas, the study will focus on school populations, and will have a secondary objective of evaluating the benefits of programs which stress vocational training for the handicapped as compared to more traditional work-study programs. In all settings, subjects identified for study will first be evaluated with a comprehensive battery measuring functional capacities considered to be predictive of later adjustment. Most of the measures will involve individual testing, although ratings of adaptive behavior will also be collected. Questionnaires will be used to collect information about the programs and services which these clients then receive. Adjustment to a work setting will be assessed with a rating scale completed by work supervisors, and finally, through interview procedures and client evaluation, benefits derived from rehabilitation services will be assessed approximately two years after the initial assessments are conducted.

FINDINGS TO DATE: Literature reviews on the relationship of IQ to social and vocational adjustment of the mentally retarded and on the special problems of learning disabled persons are nearing completion, and a battery of assessments has been identified. Data collection began in the summer of 1978.

APPLICABILITY: Rehabilitation agencies have expressed concern regarding the implications of introducing the American Association on Mental Deficiency's definition of mental retardation into rehabilitation practice because they perceive that many persons in the borderline range of intelligence, who would no longer be considered mentally retarded, have difficulties which constitute a vocational handicap and can benefit from rehabilitation services. Thus, this study should identify the nature and extent of deficits in this group as compared to mentally retarded groups, as well as indicate problems the borderline IQ person encounters during rehabilitation and eventual outcomes. At the same time, by attending to the severely mentally retarded client, the study will provide guidance to rehabilitation agencies as they strive to fulfill the mandate to give priority to the severely handicapped by indicating the functional deficits in this group and the critical relationships between process and outcome in their rehabilitation.

242 Interview Skills of the Retarded: Deficiencies, Consequences, and Training Approaches

Principal Investigator:	**Carol K. Sigelman, Ph.D.**
Status:	**New**
Dates:	**September 1977-September 1979**

Texas Tech University

Cost:	**Annual $31,950** **RT Annual $24,725**	**Projected Total $63,900** **RT % of Annual Total 77%**
Annual Report Reference:	**#7, Page 319, R-41**	

OBJECTIVES: The main objective of the study is to establish, by presenting videotaped interviews to personnel interviewers, rehabilitation counselors, and college students for ratings, which verbal and nonverbal skills are predictive of the mentally retarded client's making a favorable impression in a job interview situation, and which, as a consequence, would be prime targets for training efforts. Additional objectives are as follows:

1. to establish for a population of severely to mildly retarded adults the level and variability across subjects of verbal and nonverbal communication behaviors;
2. to determine relationships among communication behaviors;
3. to assess the relationships between communication behaviors and client characteristics such as sex, IQ, adaptive behaviors, and length of institutionalization;
4. to determine whether communication skills are predictive of current vocational functioning levels;
5. to determine the extent to which responsiveness to the demands of a question is a function of the type of question asked;
6. to assess the extent to which providing raters with information about client intelligence, motivation, and job skill reduces reliance on communication behaviors as a basis for evaluative judgment; and
7. to test the relative effectiveness of modeling and videotape feedback procedures in modifying communication skills found to be deficient and associated with making negative impressions on raters.

METHODOLOGY: Ninety mentally retarded adults (both males and females) in the severe, moderate, and mild ranges of retardation were videotaped while participating in a "pretend" job interview situation. All of the subjects came from an institutional setting.

A standard interview format was constructed covering two topic areas: vocational maturity and social maturity, with sixteen parallel questions in each topic area. Within topic areas, the types of questions asked (e.g., yes-no, either-or, what questions, and open-ended questions) were systematically varied so that responsiveness to communication demands could be examined as a function of question type. The interviews lasted approximately 5-10 minutes, and were preceded by a warm-up period during which the research and the presence of the videotape camera were explained.

Measures of communication performance in the interviews consist of the following: 1) responsiveness to communication demands of questions; 2) number of words in garbles, phrases and one word responses, and T-units; 3) total number of words; 4) number of T-units; 5) frequency of eye contact; 6) smiling; 7) head obstruction; 8) fidgeting; 9) speech intelligibility; and 10) physical attractiveness. Many of the verbal and nonverbal measures were used in the pilot research, but several new measures have been added to enhance predictive power.

Data on client characteristics such as sex, IQ, length of institutionalization, and adaptive behavior have been collected from client files. Correlational analysis and analysis of variance will be used to examine the relationships of these variables to communication behaviors, as well as the relationships among communication measures.

Segments of the videotapes for the 90 subjects have been arranged in random order and prepared for presentation to rating groups. All interviewees are shown responding to the same 8 questions from the job interview format, with each segment lasting approximately one minute. Three rating groups are proposed: a) personnel interviewers, obtained through business administration classes at Texas Tech; b) vocational rehabilitation counselors; and c) graduate students in Special Education. An interview rating scale has been developed which consists of semantic differential style items with seven points along a positive-negative continuum concerning intelligence, communication, personality, employability, and so on. Each rating group will view all 90 taped interviews so that differences among rating panels will not confound the analysis. Each of the three rating panels will consist of six to eight persons and will review tapes in four installments of 22-23, so that fatigue does not enter in.

Because in reality, personnel interviewers and rehabilitation counselors generally gather information about the client's capacities, work experience, and job skills, a secondary study will be conducted in which descriptions of each client viewed on videotape are systematically varied. For this study, raters will be provided with brief descriptions of each interviewee before viewing the videotape.

The descriptions will be systematically varied such that each interviewee is described as: a) high or low in intellectual functioning and general adaptive ability; b) high or low in motivational factors; and c) high or low in job skills and experience. Fifty-six interviews will be used in this study so that there will be seven interviewees with each of the eight possible combinations of intellectual functioning, motivation, and job skill levels.

In analyzing the relationship between communicative behaviors and evaluative ratings, correlational analysis and factor analysis will be used to reduce potential predictors to a small set of relatively independent variables which can be entered singly and in combination in multiple regression equations. A 2x2x2 analysis of variance design will be used to assess the effects of information about intelligence, motivation, and job skill on evaluations, and these factors will also be entered along with communication measures in multiple regression equations to determine if rater knowledge of the client's vocational assets or deficiencies results in less reliance on communication cues.

The previous analyses will provide the basis for selection of skills to be trained. Skills which prove to be deficient in a substantial proportion of the population and which are significantly correlated with evaluative ratings will become the target behaviors to be modified.

Subjects will be randomly assigned to one of four groups: 1) modeling; 2) videotaped feedback; 3) modeling plus video feedback; and 4) interview practice control.

The subjects' performance in the standard interview will serve as pretest measures of baseline performance. Following treatment, the subjects will again be videotaped responding to the same interview questions administered by the same interviewer. Posttreatment communication scores will be obtained on the target behaviors. The posttreatment videotapes will also be viewed by one of the same group of raters previously used, new ratings will be obtained, and changes calculated.

FINDINGS TO DATE: The following findings have emerged from a pilot study in which 21 moderately and mildly retarded women at the Lubbock State School participated in simulated job interviews:

1. Responsiveness to communication demands of different types of questions could be measured reliably, and was in part a function of the type of question asked.
2. Verbal and nonverbal behaviors were independent of one another. Highly verbal subjects were no more likely than those with limited verbal skills to engage in positive nonverbal behavior.
3. While one could predict verbal skill from IQ score, nonverbal performance could not be so predicted.
4. However, both nonverbal and verbal performance measures predicted evaluative ratings or impressions made in the interview.

IQ, three verbal measures (mean sentence length, responsiveness to the formal demands of questions, and variety of vocabulary), and three nonverbal measures (eye contact, smiling, and lack of obstruction of the head through contorted postures or obscuring the face with the hands) were used to predict ratings of intelligence, personality, quality of communication, general impression made in the interview, and likelihood that the rater would hire the applicant. These measures accounted for fully 80% of the variance in the total rating given by business students with personnel interviewing experience (F = 6.12; df = 7.11, p = .005). Those persons who used long sentences, made frequent contact with the interviewer, and did not mask or hide their faces tended to be rated positively. Moreover, nonverbal behaviors were the subject of 56% of the raters' comments in response to a question asking them which things the applicant said or did which made an unfavorable impression on them. These findings are particularly impressive when one considers what was not measured—e.g., physical appearance and attractiveness, vocal aspects of speech such as tone of voice and hesitations, and the acceptability or veracity of statements made.

It was felt that these findings were promising enough that they should be pursued. The present study improves upon the pilot study by including a larger sample, a more standarized interview format, and more than one group of raters to judge interviewees.

APPLICABILITY: The study is directly relevant to rehabilitation practitioners concerned with communicating with mentally retarded clients and increasing their clients' competencies in job interviews and other social interactions. Specifically, it will identify communication skills which are deficient; shed light on the effects of the types of questions posed to the mentally retarded on their communication behavior; offer information about how rehabilitation professionals and others react to the communication behaviors of the mentally retarded; indicate which communication behaviors are consequential enough to warrant intensive training efforts; and evaluate alternative training procedures to aid trainers and teachers in remediating skill deficiencies which decrease social and vocational acceptability of mentally retarded clients.

It is believed that trainers and teachers may benefit simply by learning which communication skills are deficient among the mentally retarded and affect the ways in which they are evaluated. The measurement techniques developed for the study will be usable by trainers in assessing needs. Finally, the study will provide trainers with techniques demonstrated effective in remediating communication skills deficits.

The research is expected to improve techniques for identifying communication skill deficiencies and upgrading such skills.

243 Issues in Deinstitutionalization

Principal Investigator: **Carol K. Sigelman, Ph.D.**
Status: **New**
Dates: **September 1977-February 1979**
Cost: **Annual $21,340** **Projected Total $32,010**
RT Annual $16,445 **RT % of Annual Total 77%**
Annual Report Reference: **# 7, Page 337, R-42**

OBJECTIVES:

1. To describe the adjustment processes of more severely disabled persons furloughed from state institutions for the mentally retarded in Texas to the community, comparing them to higher level clients.
2. To assess which types of clients receive which types of environmental support, which types of environmental support facilitate adjustment, and which types of clients benefit from such supports.
3. To determine, for a sample of persons for whom both clients and guardian or houseparent interviews were collected, the extent to which clients and significant others agree in their responses, and the extent to which profiles of adjustment and correlates of adjustment from these two sources of data are consistent.

METHODOLOGY: This study is an extension of analyses of a large longitudinal data set collected as part of Project R-21. The methodology consists of data set organization, data reduction, and statistical analysis appropriate to the stated objectives.

FINDINGS TO DATE: Due to shortages of funds, the present project, although approved for initiation, has been held in reserve for a late start.

APPLICABILITY: Deinstitutionalization has been a priority in both RSA and the Office of Developmental Disabilities. The Center's rich longitudinal data set is unique and can provide knowledge relevant to community adjustment processes and the facilities and services which facilitate those processes. In this study, special attention will be focused on the more severely handicapped person and on environmental, as opposed to personal, correlates of adjustment.

244 Models for Services to the Severely Handicapped

Principal Investigator: **John Felt Buddington, Ph.D.**
Status: **New**
Dates: **September 1977-August 1980**
Cost: **Annual $106,734** **Projected Total $238,253**
RT Annual $90,928 **RT % of Annual Total 85%**
Annual Report Reference: **# 7, Page 180, R-43**

OBJECTIVES: At the conclusion of the project, we shall have produced the following:

1. A description of the actual operations of five vocational rehabilitation agencies which have been designed to be responsive to the portions of the 1973 Rehabilitation Act relating to severely handicapped individuals.
2. A generic description of a rehabilitation agency that **may** be called upon to address all relevant problems of any severely handicapped individual.

METHODOLOGY: The project will produce the descriptions of the operation programming and the generic program in the course of four phases. These phases include:

Phase I: Preparation and Planning

This phase will yield at least two models which describe (a) the objectives of the project, (b) a set of intermediate states of the project which denote its progress in meeting its objectives, (c) monitors which document its success, (d) procedures for attaining each intermediate state, (e) procedures to improve the project's effectiveness over time, and (f) all other activities necessary to support the above.

Phase I will be completed by abstracting the literature, making site visits, describing two models, and revising these models with the advice of selected members of CSAVR.

Phase II: Request for Proposals

This phase is designed to yield at least five proposals which promise to serve severely handicapped individuals in a more effective fashion than is being done by existing agencies.

Phase II will be completed by distributing the models derived from Phase I to state vocational rehabilitation and blind agencies. Details of how the states may respond to the RFP will be included. Consultation to assist states in preparing their proposals will be offered.

Phase III: Technical Assistance

This phase is designed to yield five programs which operate in the fashion promised by their respective proposals. Phase III will be initiated by the granting of roughly $100,000 from RSA to each of five vocational rehabilitation agencies. Site visits will be made by project staff to assure that the technical aspects of the proposal are being carried out as promised. Project staff will be available during site visits and at other times for consultation.

Phase IV: Evaluation

This phase will yield a description of the results actually attained by each of the five projects, two years after funding, as measured according to the objectives adopted by each agency. In addition, changes in the operation of the agency will be described, together with any deviations from the proposal. The description of the actual status of the five funded agencies (including any planned changes and any deviations from the proposal) will constitute the "description of operating agencies" called for in the first objective of this project. A generic description of a rehabilitation agency, the second objective called for, will be derived from the description of the five agencies in combination with the "sample description" completed in Phase II.

FINDINGS TO DATE: Phase I has been completed, except for the approval of the models by the CSAVR committee and by the project officer in RSA.

The review committee recommended that the following individuals should constitute the first priority of those to be served: (a) individuals living in rural areas, (b) individuals currently residing in an institution, and (c) individuals who are homebound. The committee indicated no preference as to the type of problem which should be addressed. It agreed that the first priority for essential elements to be installed should be those direct-treatment procedures not locally available.

The models submitted for approval concern rehabilitation engineering and an "intensive rehabilitation program."

APPLICABILITY: Each description of a project which meets the requirements of the 1973 Rehabilitation Act may be employed as one of several approaches which could satisfactorily address the problems of the severely handicapped. The six essential elements for describing such programs could form the basis for an orderly, concise, and comparable way of describing programs and their effects and costs for program-planning and zero-based budgeting purposes.

It is expected that vocational rehabilitation agencies will be motivated to modify their programs to deal with greater numbers of severely handicapped individuals. Present experience indicates that few existing programs are capable of dealing with the required numbers of severely handicapped individuals. This project will yield models which are not only appropriate for these agencies, but also ones which they are motivated to adopt.

245 Development of Exemplary Models of Achieving Effective Coordination of Education and Vocational Rehabilitation in Local Communities

Principal Investigator: **Gerard J. Bensberg, Ph.D.**

Texas Tech University

Status:	**New**	
Dates:	**October 1977-May 1979**	
Cost:	**Annual $112,728** **RT Annual $99,766**	**Projected Total $99,766** **RT % of Annual Total 89%**
Annual Report Reference:	**# 7, Page 187, R-44**	

OBJECTIVES: The purpose of the project is to determine what forms and mechanisms of cooperative programming by vocational rehabilitation, public school programs, and other community agencies can improve the quality of services to handicapped youth. Specifically, the project will culminate in a state of the art report, detailed descriptions and analyses of ten exemplary programs involving interagency cooperation, and a synthesis of models in a model or models replicable nationally.

METHODOLOGY: Literature review will focus on describing current public school/vocational rehabilitation programs and interagency linkages and will serve as background for describing the state of the art and constructing questionnaires and interview schedules to be used in site visits. A form will be developed to solicit nominations of outstanding programs from vocational rehabilitation agencies, state education agencies, and other relevant sources. A follow-up questionnaire will be sent to nominated programs to solicit information that can be used, along with telephone contacts, as a basis for selection of ten exemplary programs. Site visits will be conducted by a carefully chosen visitation team using structured and open-format questionnaires, interview schedules, and data collection forms. The data collected from site visits, along with the material identified through literature review, will serve as the basis for developing program models which represent comprehensive and effective cooperative programs to maximize the vocational potential of handicapped youth.

FINDINGS TO DATE: The literature review is underway. Letters soliciting nominations of programs which meet specified criteria have been mailed, and a follow-up questionnaire to be sent to nominated programs has been constructed. Work is underway to develop the information goals and more detailed data collection procedures to be used in the site visits.

APPLICABILITY: Interagency linkages are a priority in RSA research and evaluation objectives. This project should provide guidance to vocational rehabilitation agencies as to how they can work most effectively with public schools and other community agencies to provide vocationally-oriented training and experiences to handicapped youth. This project is particularly timely in view of recent legislation in vocational rehabilitation and in education which has altered the missions and responsibilities of both and which requires a reshaping of cooperative relationships between agencies.

University of Wisconsin-Stout (RT-22)
Vocational Rehabilitation Research and Training Center

CORE AREA

Vocational Evaluation

The development and dissemination of new knowledge in vocational evaluation and the client service areas interfacing with vocational evaluation, (which include work adjustment, vocational training, follow-up and counselor/client decision making), and also the development of demonstration programs in the areas of client referral to vocational facilities and effective facility service utilization.

UNIVERSITY OF WISCONSIN-STOUT

Daniel McAlees, Ph.D., Director
University of Wisconsin-Stout
Stout Vocational Rehabilitation Institute
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PROJECT TITLES BY FY 1978 STATUS

COMPLETED

ABSTRACT NO.

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Accuracy and Consistency of Data Collected on Client Characteristics in Facilities

University of Wisconsin—Stout

Research and Training Utilization and Integration

PROPOSED

The Use of the Functional Capacities Inventory in the Delivery of Services

Facility Services—A Tracking Study

An Exploratory Study of the Vocational Decision-making Skills of Vocational Evaluation Clients

The Effects of Vocational Evaluation on the Vocational Rehabilitation Client and Counselor

The Point Sampling Approach to Assessing and Monitoring Behavior in Adjustment Programs

246 Effects of Vocational Evaluation Programming on the Vocational Development of Rural High School Youth

Principal Investigator: **Fredrick Menz, Ph.D.**
Status: **Completed**
Dates: **September 1972-February 1978**
Cost: **Annual $17,429** **Projected Total $47,000**
RT Annual $10,229 **RT % of Annual Total 59%**
Annual Report Reference: **#6, Page 65, R-5**

OBJECTIVES: The Equal Opportunities Projected funded by ESEA consists of exposing reluctant learners in 20 school systems to a vocational evaluation experience which concentrates on vocational exploration and goal study. A second component of this project involves the project staff in developing school-vocational program recommendations for each student jointly with the student, school personnel, and parents. The third component involves follow-up with school personnel in implementing these recommendations, as need requires. Finally, regular periodic follow-up counseling is provided by the project staff to students after they return to school. The objective in the program evaluation of the Equal Career Opportunity Project (ECO) were a) to identify short and long-term effects of vocational evaluation on vocational development and b) to identify short and long-term effects of vocational evaluation and school follow-up on school-related behaviors and continuing vocational development.

METHODOLOGY: Students participating in the ECO Program during FY 1973 (N=140), 1974 (N=120), and 1975 (N=90) were the samples for this project. These students are referred to as reluctant learners and were identified by the schools as students characterized by having low academic achievement, high potential for drop-out, poor attendance, tardiness, etc. Two types of data were collected respective to the two goals of the ECO project: Student data on the CMI, a norm-referenced measure, and data on students obtained with questionnaires developed and highly specific to the intents of the project. Criterion levels for each objective were pre-established and evaluation of the attainment of the several objectives was conducted against these for the projects vocational development and school goals. Simple t-tests and descriptive statistics were input into a basic judgement scheme to formulate judgements as to whether the project appeared to be attaining each of its goals.

FINDINGS TO DATE:

Attainment of the Vocational Development Goal.

ECO had a definite impact upon the attitudes of students toward entry into the world of work and career choice. It also tended to have positive impact upon the students' 1) ability to appraise vocational and educational capacities; 2) to solve problems related to career choice, and 3) to plan strategies for pursuit of a career. These findings are reported by professionals' judgements and tends to be corroborated with pre- and post-measures obtained from the CMI. By the end of vocational evaluation reluctant learners do not appear to have developed a capacity to utilize occupational information or formulate and select goals as evidenced by the data sources employed in this evaluation. However, there is some evidence to indicate that this capacity does develop by one year after evaluation.

Attainment of the School Goal.

Attainment of objectives and progress toward this goal of establishing more positive behaviors in school is mixed, with generally good effects on specific dimensions. Effort and quantity and quality of school work significantly improved within one year of participation in the program in both the vocational and academic areas (see Ferstenou's study below). Students tended to be better adjusted to school after vocational evaluation, but this adjustment did not appear to be maintained. Their interest in school was not consistently found to be as positive as other students. Their attitudes toward themselves improved subsequent to evaluation and appeared to be maintained after one year. Finally, they tended to develop a better capacity than other students, to formulate vocational goals. They do not appear to lose this capacity after a year back in school.

APPLICABILITY: Vocational evaluation has been found to have an effect on the vocational development of clients. Further, the two-week vocational evaluation in conjunction with in-school follow-up tend to have modest but positive effects on social behaviors of clients. A model to optimize the vocational and social effects of evaluation is suggested as applicable in school and training-based evaluation programs. The model essentially involves overlapping and integrating vocational counseling and guidance into a sequenced vocational evaluation. Viewed as a course, the evaluative findings and the client's reactions to them are systematically built upon during the 8 to 16 weeks which this process might involve during the training program or school semester.

247 Identification of Work Reinforcers Found in Sheltered Workshops and Their Relationship to Client Vocational Needs

Principal Investigator:	**Fredrick Menz, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1972-November 1977**	
Cost:	**Annual $17,429** **RT Annual $10,229**	**Projected Total $30,000** **RT % of Annual Total 59%**
Annual Report Reference:	**# 6, Page 77, R-9**	

OBJECTIVES:

1. To determine the pattern of work reinforcers characteristic of workshops in general.
2. To determine the pattern of vocational needs characteristic of workshop clients.
3. To determine the relationship between characteristic work reinforcer and client vocational need patterns.
4. To determine the feasibility of providing an extended range of work reinforcers within the workshop setting.

METHODOLOGY: The sampling unit for this project was the sheltered workshop unit. Five sheltered workshops, using the Minnesota Importance Questionnaire, were identified and requested to participate in the project. The variables of interest were the twenty common work reinforcers identified by the Work Adjustment Project, University of Minnesota. The Minnesota Importance Questionnaire and Minnesota Job Description Questionnaire were used to collect the data. Workshops participating in the project already have Minnesota Importance Questionnaire data available on clients. Workshop supervisors and professional persons were asked to complete a Minnesota Job Description Questionnaire indicating the reinforcers available to clients under their supervision. Client and supervisor data are being analyzed on each reinforcer dimension using analysis of variance to determine if there are any between workshop differences.

The interaction of client need profiles and reinforcer profiles were studied using discriminant function analysis. Within-workshop means on the 20 MJDQ reinforcer scales were used to adjust client scores on the corresponding MJQ need scales. There 20 estimates of need-reinforcer congruences were used to determine whether workshops could be differentiated in terms of the degree to which the 5 workshops were providing reinforcement at the same need level expressed by clients.

FINDINGS TO DATE:

Interaction of Client Needs with Availability of Reinforcers:

The basic result of the discriminant analysis indicates that workshops differ significantly in terms of how congruent reinforcers of client needs are with the pattern and level of reinforcement clients seem to require. The secondary result of this analysis is that each of the discriminant functions was found to discriminate, indicating there are four major ways in which the workshops are similar or dissimilar to each other.

The different linear combinations of weights and estimates of need-reinforcer congruence, composing the discriminated centroids under each function, project the uniqueness of the five workshops. From this analysis, we can conclude that workshops C and E are most distinguishable from the other workshops in the manner in which they reinforce needs; that D represents a cross-section of the other four workshops; that workshop A tends to be similar to D; and that workshop B tends to be similar to E in the levels of congruence with which reinforcers are being provided to the dominant vocational needs of clients. Use of need-reinforcer congruence estimates are, therefore, found to be quite effective as a means to describe an important dimension of different work adjustment programs: The dimension being how well a given workshop is able to provide reinforcers for clients' idealized vocational needs.

Feasibility of an Extended Range of Reinforcers:
Two analyses were conducted with need-reinforcer congruence estimates to obtain an idea of whether or not reinforcers might be extended: The extraction of the need-reinforcer dimension which principally, did and did not differentiate the workshops on each function and the identification of relative congruence of need to reinforcer. In these two analyses, the issues were which ones do and do not discriminate and whether client levels of need are greater than the available level of reinforcers.

In terms of the absolute degree to which workshops provide reinforcers which are congruent with their clients vocational needs, we have found that four of the five workshops are particularly unique on the basis of subsets of a limited number of dimensions (12 of the 20), that they share other combinations commonly, and that they cannot be differentiated among on the basis of 8 of the dimensions. In the final analysis we found that it is with rare exception that the level of reinforcement available exceeds the clients' levels of vocational need. More often than not, client need-levels are significantly greater than the levels of available reinforcement. The distinction among workshops is based upon dramatic contrasts involving the workshops ability to provide congruent reinforcers for their clients' needs on one limited set of dimensions, while simultaneously being unable to provide commensurate levels of reinforcement for a second set of client vocational needs.

The distinction among workshops is not to be found in terms of one workshop being consistently lower or higher on all those parameters which play an effective role in differentiation, but rather in terms of profiles of congruence and incongruence on specific subsets of the need-reinforcers. These important distinguishing profiles reflect the balance of reinforcements which intentionally or accidentally have been arrived at in each workshop. Altering this balance may involve simultaneously diminishing or expanding one or more of the other reinforcer dimensions. To unilaterally conclude that expansion of reinforcers is possible would ignore the finding of this study that important and complex differences exist among workshops and unwittingly presume that the patterns of congruence and incongruence within each workshop occurred in a random fashion.

It is conceivable that a wider range of reinforcers can be provided. But, it is highly advised that this expansion of reinforcers take into account both the profile of need-reinforcer congruence in those facilities which more adequately provide appropriate reinforcements for given needs and the operational and programming characteristics which make this profile of specific congruences possible. Having found that workshops differ in terms of specific profiled subsets of need-reinforcer congruence estimates, it is unwarranted to speak of altering a specific need-reinforcer without fully considering the complete subset of need-reinforcers in which the need-reinforcer of concern operates in some balanced fashion.

APPLICABILITY: Findings of the research can be utilized by rehabilitation facility personnel, particularly those in work adjustment and training programs, to identify important work reinforcers available in their programs. The fact that effective and interpretable differentiation has resulted in using need-reinforcer congruence estimates suggests two things. First, adjustment services do differ and useful descriptions of them might be obtained using this estimation procedure. Secondly, given additional applied research studies to determine whether consistent descriptions might be meaningfully obtained, to match individual client MIQ profiles with MJDQ profiles for a variety of work adjustment settings may help to improve the referral of clients to adjustment services which best meet their vocational needs. The delivery of services through the vocational rehabilitation counselor might be greatly impacted upon if the findings of the present research are replicated and found usable in the fashion suggested here.

248 Process and Outcomes of Vocational Evaluation Services

Principal Investigator:	**Dennis Dunn, Ed.D.**	
Status:	**Completed**	
Dates:	**April 1974-July 1977**	
Cost:	**Annual $16,992**	**Projected Total $90,000**
	RT Annual $9,792	**RT % of Annual Total 58%**
Annual Report Reference:	**#6, Page 89, R-20**	

OBJECTIVE: To measure the impact of vocational evaluation services upon client change. (Vocational evaluation client's characteristics, vocational evaluation personnel characteristics, and significant vocational evaluation techniques will be identified. The interrelationships of these variables will be studied to determine their effects on client change).

METHODOLOGY:

1. Identification of characteristics of vocational evaluation clients.
2. Identification of characteristics of vocational evaluators.
3. Identification of Vocational Evaluation Techniques.

PROGRESS AND FINDINGS: The identification of client characteristics has been attained. Survey data suggests that clients referred for vocational evaluation services could be categorized into three groups depending upon their characteristics and service needs. The first group is comprised primarily of younger (less than age 24) single clients who are mentally retarded or have developmental disabilities and little or no work experience. This group has functional problems related to vocational development and maturity and would be most likely to benefit from a vocational evaluation program which stresses the development of personal and social awareness related to vocational success. The second group of referrals are those who are older, married, and possess a reasonably good vocational history and skills, and typically have an acquired disability. This group would probably best benefit from a placement oriented vocational evaluation program. The third group is made up of clients who are older, have less than high school education, have had either no work experience or four or more jobs, have multiple handicapping conditions and display extreme behavior patterns or difficulty conforming to rules. This group would best be benefitted by an orientation and adjustment program prior to evaluation.

Research on techniques for objectively observing client work behaviors suggested that: (1) client behavior can be objectively and consistently described in observable form; (2) behavioral norms can be established within rehabilitation facilities; (3) individual behavior profiles based on standard scores are easily interpretable; and (4) there are significant differences in observed client behavior patterns between facilities and between programs within facilities.

Additional studies undertaken on the point sampling behavior observation method indicated that interobserver agreement was in the .90's, while observer accuracy was typically at the 92% level or beyond. A comparison of the accuracy of point sampling with other observation strategies indicated that it, overall, was the method with the highest accuracy, reaching the 99% level with 80 or more observations. However, it was also found that observational accuracy is a function of the specific behavior being observed, the observational method used, and the number of observations made. In a related study, the test-retest reliability of a behavioral rating scale as a function of the length of time an individual was in a program was examined. These results suggested that it was only after an individual has been in a program for 12 days or more that ratings were sufficiently reliable (.70 or beyond) to be of value in individual programming.

Other findings of significance during this reporting period include: (1) Mentally retarded client performance on simulated work tasks can be improved by some 10-18% by the simple expedient of setting a goal; (2) individual learning equations developed from initial task acquisition data can predict subsequent performance with an average error of less than 1%; (3) the use of industrial norms may result in unnecessary rejection of clients for certain occupational areas.

The several activities of this project have been completed and promising research ideas have been incorporated into proposed research projects.

APPLICABILITY: Numerous implications for practice changes have emerged from the project, as has been detailed in the previous Progress Report. These included use of objective behavior observation techniques; a method for scheduling and making accurate observations; setting performance expectations for clients as a means of increasing their performance rates; providing practice when industrial norms are used; and a method for developing content valid work samples. Journal articles, Center research reports, and Center training programs have been used to effect practice changes in line with these research findings.

249 Differential Treatment of Functional Disabilities in Work Adjustment Programming

Principal Investigator:	**Charles Coker, Ph.D.**	
Status:	**Completed**	
Dates:	**September 1975-June 1977**	
Cost:	**Annual $16,179**	**Projected Total $48,000**

University of Wisconsin—Stout

RT Annual $8,979 **RT % of Annual Total 56%**

Annual Report Reference: **#6, Page 95, R-21**

OBJECTIVES: If "work adjustment" is viewed as a program rubric for adjusting persons to work rather than a "treatment" in and of itself, it is recognized that this program could be implemented from several theoretical perspectives. There are two major obstacles facilities face in offering differential treatment modalities within work adjustment. They are:

1. insufficient or limited treatment skills repertoire by facility staff, and;
2. an inability to establish a clear programmatic model of work adjustment by facility staff. The research objectives are:
   a. to survey facilities to ascertain the types of treatment(s) offered in work adjustment along with descriptions of types of client problems confronted;
   b. to develop specific treatment modules with respect to facility needs and to determine their overall effectiveness.

METHODOLOGY: The project involves three different activities requiring different methodologies. These are:

a. Develop and validate specific work adjustment treatment modules. The procedure to be followed for this activity is essentially an iterative developmental approach with the following steps:
   (1) Select client problem area: Significant work adjustment client problem areas will be selected on the basis of existing RTC data, data to be collected from short-term RTC trainees, and other information resources.
   (2) Develop treatment module: During this phase, each problem will be stated in behavioral terms along with a goal or desired behavior. The literature will then be searched to locate one or more specific treatment techniques which have been shown to be effective in dealing with the problem. Each treatment technique will be written up in a step by step format. Additionally a method for determining the effectiveness of the treatment technique will be developed.
   (3) Field test treatment module: Each treatment module will be field tested in one or more work adjustment programs.
b. Develop functional classification system.
c. Develop work adjustment treatment package. The third and final phase of the project involves the development of a comprehensive treatment manual for work adjustment problems organized around the functional classification system. This manual will be based upon the empirical evidence gathered during the developmental phase. It will be field tested in a manner similar to that used to develop the initial treatment modules, i.e., by being installed in selected facilities or programs and data gathered to determine the effectiveness of the manual.

FINDINGS TO DATE: Based on preliminary surveys of problems in the field of work adjustments and further model building, there exists a decisive lack of concrete definition of work adjustment and use of specific treatments for specific disabilities. The project's intent to solve these problems was noteworthy, but the all inclusive nature of the problems could not be handled with the R & T Center budget and staff restriction. This project, therefore, will be discontinued in favor of more detailed projects dealing with specific aspects of the genesis work adjustment programming. Work is currently underway to complete a treatment module on "Analysing Performance Problems in Work Adjustment Programming."

The initial concentration of matching a functional disability with a specific treatment is on performance problems in work adjustment programming. Assessment includes observation of on-task/off-task behaviors in relation to production measures. Specific treatment module to be tested is the pacing of performance through electronic instrumentation. Procedures for analyzing performance problems are currently being devised and application of these procedures at field sites is being arranged. Initial pilot studies indicate increase in production, but performance of these changes has not been assessed.

APPLICABILITY: This project was geared for direct practitioner utilization in its developmental and field trial phases. The project has the positive aspect of organizing treatment skills and techniques in a highly usable format. The introduction and testing of work adjustment models and treatment implementation can serve to clarify for the practitioner the usefulness of theory-based treatment approaches. Administrators and policy makers could have a model around which they could organize and evaluate work adjustment programming for maximum effectiveness.

University of Wisconsin—Stout

250 The Effects of Vocational Evaluation on Client Vocational Awareness Attitude and Competency

Principal Investigator: **Fredrick Menz, Ph.D.**
Status: **Completed**
Dates: **September 1974-May 1978**
Cost: **Annual $18,928** **Projected Total $28,000**
RT Annual $11,728 **RT % of Annual Total 62%**
Annual Report Reference: **# 6, Page 113, R-23**

OBJECTIVE: The Wisconsin Division of Vocational Rehabilitation has set up a demonstration project entitled Concentrated Assessment and Diagnosis in Rehabilitation Entrance at the Waukesha Office. This project has been set up to determine the advantages of early assessment of the severely disabled in their rehabilitation. Consistent with this objective are aims which include reduction in costs for and improved quality of evaluation and more effective utilization of community resources. The focus of the project is on reducing the time delay between referral for evaluation and assessment of clients by basing a Singer Vocational Evaluation System in the office and locating a JEVS System at the Waukesha Training Center. The Center's emphasis in this effort is to determine the immediate effects of vocational evaluation on client vocational orientation.

METHODOLOGY:

a. Samples: Samples for this study include all counselors at the Waukesha office and all clients entering the Waukesha office between December 19, 1974 and March 1, 1976 and referred for vocational evaluation.

Counselors provide ratings on behaviors of all clients referred to vocational evaluation during this period. Counselor referrals will be "natural", i.e., no attempt will be made to impose structure on the referral process. Both estimates of client functioning and direct measures of their vocational attitudes and competencies will be blocked during the analysis stage on disability and sex characteristics.

b. Variables: Client demographic variables as sex, disability, referral source, funds expended, and risk group classification are being collected from office records. Counselor demographic variables as sex, experience, and referral patterns will also be collected.

The dependent variables are client vocational awareness, client vocational attitude, and client vocational competency.

Procedures: At referral, counselors rank each awareness area in terms of its relative importance as an effect of vocational evaluation on the client. Immediately after the counselor's first contact with the client, subsequent to vocational evaluation and prior to receiving the evaluation report, the counselor rates the client's functioning in each awareness area. If the client is referred to the office-based evaluation, the evaluator independently estimates the client's level of functioning in each area.

The effects of vocational evaluation on client attitude and competency will be estimated in a "separate sample pretest-post-test design." Clients referred to the office-based unit are randomly assigned to a pre-or post-testing with the CMI.

Demographic data on clients and counselors will be employed in the analysis of the data collected on clients referred to vocational evaluation to most adequately explain measured effects. The effects of vocational evaluation on client vocational awareness will be studied in a Program Sex Disability factorial analysis of variance design. Effects of vocational evaluation on attitude and competency will be studied in Sex Disability repeated measures analysis of variance design.

FINDINGS TO DATE:

CADRE Program Structure

The evaluation unit served between 1 and 7 clients per week over a 42 week period. The typical number served each week was between 2 and 4 clients with a rough median client-evaluator ratio of 3:1. Sixty-nine percent of the clients referred for the service were males and 31% females and all were in the service between 1 and 10.5 days. Most typically, the service duration was 4.5 days and very rarely lasted more than 6 days. Eighty percent of those referred to evaluation completed, with 16% dropping out prior to completion, and only 4% reported as not having shown up once the referral contact was established.

During the evaluation, 71% were able to identify at least one job that they had had and liked, with

62% identifying 1-2 jobs, and 9% identifying 3-5 jobs. In all, 64% of them could also state at least one thing about the job which caused them to say that they liked the job. When asked whether there was work which they would have confidence in their ability to do, 24% could not identify any such work, while 18% could identify 3 or more types of jobs, and another 58% could identify at least one job.

In the previous five years, 43% of the clients had not held jobs, while 45% had held at least one, and 12% had between 2 and 3 different jobs. This high percent of unemployment, however, is partially reflected in the fact that 31% were still in school, 32% had left school before they were 18, and 55% of the group were planning further schooling or training.

Weschler intelligence scores and WRAT reading and arithmetic scores were available for a high proportion of the clients. Cognitively, the client had higher functioning than is generally found in vocational evaluation services, but were functionally ill-prepared in literacy and computational skills.

The general evaluation included combinations of aptitude, interest, and personality inventories, and various combinations of the 16 Singer evaluation units based upon the evaluator's decision.

Effects of Vocational Evaluation

In the evaluation of the effects of a two-week vocational evaluation service on adolescents, Mueller and Menz (1976) administered the Career Maturity Inventory to the students prior to beginning evaluation and immediately after. In that study, highly significant ($p < .01$) improvement in student attitudes toward entry into the world of work occurred, along with a general tendency ($p < .10$) for them to improve their abilities to plan entry into the world of work, formulate and select vocational goals, solve problems related to school and career choice, and appraise their own vocational and educational capacities.

The present study attempted to determine whether such findings would be obtained with a typical rehabilitation group in a service of shorter duration. The CADRE evaluation was essentially an abbreviated form of the evaluation which the adolescents in the Mueller and Menz study had received. There were no changes in client vocational attitude or competencies as a result of the 4.5 day evaluation. A short screening type evaluation does not produce significant changes in clients along these dimensions.

Dunn & Korn (1973) studied the effects of vocational evaluation on youthful offenders using a goal attainment scale similar to that employed in the present study. They found that clients demonstrated awareness of present vocational goals at the expected level, but over all five goal areas their attainment was consistently at the "less than expected" level. Client awareness was an expectation in the CADRE program and a goal attainment scale was completed by counselors and evaluators on a couple of the clients.

On the basis of mean ratings provided by counselors and the evaluator, these clients do not seem to be "aware" of the services they need and of their vocational qualifications and potential. Counselor and evaluator both, however, see them as aware of their vocational interests or vocational goals. These preliminary findings are similar to those found by Dunn and Korn with youthful offenders who received a two week evaluation.

APPLICABILITY: The findings of this study document the immediate client effects of vocational evaluation. With the increased concern for provision of adequate services in a timely fashion to the handicapped, the simultaneous concern has been clearly stated in the legislation that the effects of rehabilitation services must also be determined. This need for evaluation of rehabilitation services raises the issues of measurement of expected outcomes of the services. The findings of this study are applicable to both issues. They address the issue of what immediate effects should be expected from vocational evaluation. Such results in turn should be valuable to program planners, managers, and practitioners in better utilization of services toward the end of client benefit.

251 The Use of Information in Vocational Decision-Making by Disabled Persons

Principal Investigator:	**Dennis Dunn, Ed.D.**	
Status:	**Completed**	
Dates:	**July 1977-May 1978**	
Cost:	**Annual $22,004** **RT Annual $14,804**	**Projected Total $14,804** **RT % of Annual Total 67%**
Annual Report Reference:	**#6, Page 165, R-32**	

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OBJECTIVES:

a. To determine whether there are statistically significant differences between disabled and non-disabled persons in the (1) types of occupational information used for vocational decision-making and (2) number of information categories used in vocational decision-making.

b. To determine whether there are statistically significant differences between different groups of disabled persons (i.e., groups defined in terms of sex, major disability types, and prior work experience) in the (1) types of occupational information used for vocational decision-making and (2) number of information categories used in vocational decision-making.

c. To determine through content analysis the specific sub-categories of Type of Work, Skill/Aptitude, and Working Conditions information used by disabled persons in making vocational decisions.

METHODOLOGY: The Occupational Construct Inventory (OCI) was administered to 59 subjects who were clients entering a vocational evaluation program. The OCI consists of 15 plates in which three occupations are pictured. The subject is asked to decide in which way two of the occupations are similar and in what ways are they different from the third occupation. The responses were coded with respect to (1) Biggers (1971) classification scheme and (2) a content analysis classification scheme based on the Dictionary of Occupational Titles (DOT) and the Occupation Information System. Chi-Square analyses were used to determine differences in responding with respect to various demographic characteristics in relation to both classification schemes.

FINDINGS TO DATE: The findings indicated that there were distinct differences between the disabled and non-disabled groups in terms of the specific information used. The disabled group made more use of the Type of Work and Work Conditions categories (accounting for almost 80% of the total number of responses) and less use of the Skills/Aptitudes and Education categories. Also, little or no use of the Interests, Income, or Prestige/Status information categories was noted. There were no significant differences between the two groups in the number of different information categories used by individual subjects in making vocational decisions. The results indicated that subjects consistently used only two or three of the nine possible categories.

The results also showed significant differences between different groups of disabled individuals in terms of the specific types of information used in decision-making. Sex made a significant difference in how occupational categories were used. Females used fewer categories and gave more concrete answers than males. With sexual barriers being broken down in employment, females should be more fully aware of occupational information.

Disability groups used occupational categories differently, but not in the expected directions. Physically handicapped males did not use physical demands as heavily as other male disability groups; the mentally retarded used aptitudes less than other disability groups; physically disabled females did not respond at all to environmental characteristics; and the emotionally disabled used environmental characteristics less than other disability groups. These suggest that the handicapped need help in understanding their disability and assessing how it will affect them in an occupation.

Longer employment histories did increase the use of occupational traits for males. This indicates that persons with minimum work experience need to expand their knowledge and use of occupational information. Finally, there was no difference in the number of occupational information categories used when males and females were compared with each other.

The results of this study indicated that adult disabled persons were as limited in their use of occupational information as were the students in Biggers' (1971) study with a non-disabled 12th grade population. These findings suggest the need for developing remedial programs focusing upon information use in decision-making.

The importance of good occupational information programs cannot be over-emphasized since it may be all the assistance necessary to insure realistic occupational choices from disabled individuals who have clearly defined barriers to employment (Doeringer and Priore, 1971). Such programs may ultimately lead to improved methods and techniques for presenting information to disabled persons in a manner which can be best used by them for decision-making. By having access to and control over information gathering procedures, as the rehabilitation professional does, the disabled person can actively take part in the rehabilitation choices. Professionals and disabled individuals must work side by side in vocational planning and programming if individuality in the rehabilitation process is to fully come about and be maintained.

Additionally, the results indicated differences in information use between major disability groups. These findings provide content areas which need to be considered in program development and/or the use of existing occupational information materials. Particular disability groups were concerned with particular kinds of information and these areas should be incorporated into vocational programs to meet the needs of these groups of individuals. Work sample developers will also find the result beneficial since it indicates types of information which should be included in the orientation materials to the client prior to the administration of the work sample.

APPLICABILITY: The results of these studies on the identification of the relative importance of different types of occupational information in vocational decision-making by disabled persons may have four primary uses. First, the extent to which disabled persons are in need of specific programming to assist them in making effective use of information and the need for development of special programming focused upon information use in decision-making has been suggested in the study. Second, the findings indicate that there are differences in information use between different disability groups. Disabilities may need to be taken into account in program development and/or the use of existing occupational information materials. Third, the findings indicate some information which should be included in occupational information presentations intended for use with disabled groups. This may enable state rehabilitation agencies and rehabilitation facilities to evaluate existing print and non-print occupational information materials with respect to adequacy for use with a disabled population. Such guidelines may also serve to focus in-house development of occupational information which are most commonly used by disabled persons in decision-making. Fourth, the results may be used by work sample developers to determine types of occupational information that should be included in the orientation materials provided to the client prior to the administration of the work sample.

252 Telecommunications in Training of Rehabilitation Facility Personnel

Principal Investigator: **Charles C. Coker, Ph.D.**
Status: **Continuing**
Dates: **September 1975-June 1978**
Cost: **Annual $20,802** **Projected Total $37,000**
RT Annual $13,602 **RT % of Annual Total 65%**
Annual Report Reference: **#6, Page 231, R-24**

OBJECTIVES: This project's purpose is the developmental and implementation of an innovative technique to enhance the training and research of the Center. The objectives are to determine: a) the availability and costs of telecommunications systems or equipment most compatible with the training and/or research needs of the Center. b) Potential and actual benefits to training and research of the Center.

METHODOLOGY: The mechanics of the project consists of three phases:

1. Planning Factors — Determining telecommunication systems and equipment costs, advantages, disadvantages, and Center needs.
2. Demonstration Factors — Site arrangements, training material selection, and evaluation of training via telecommunication.
3. Implementation Factors — Cost/benefit analysis based on Phase I & II to determine optimal system for Center needs.

FINDINGS TO DATE: Phase I has been completed in terms of exploring various telecommunications equipment and systems. From this information, the Center has devised a tentative system relying on conference telephones of two types:

1) Telephone company conference telephones requiring installation and rental costs.
2) The Center's own cradle-type telephone conference unit requiring no installation.

The training specified above will enable the Center to maintain semi-permanent satellite training/research sites plus the flexibility of responding to short term needs. Either unit can be used with ten different sites and is suitable for small groups of 10-20 individuals. More than twenty individuals at a site may require external amplification devices. Phase II is currently underway and preliminary testing has proven satisfactory. This project is expected to reduce training/research travel costs, while at the same time increase quality and breadth of training/research.

APPLICABILITY: The need for an economical method for providing short-term training and other staff development activities to rehabilitation facility and state agency personnel is self evident. Telecommunications technology offers a way of providing a personal link between trainers and trainees while avoiding excessive travel costs and energy consumption. Through the use of conference call capabilities, it literally allows trainers to be in several places at once, thus increasing their utilization and making their expertise more widely available.

The findings will be used primarily by trainers and staff development personnel. The application of telecommunications technology may be an effective and economical means of providing short-term and in-service training to rehabilitation personnel in diverse geographical areas. There are several possible spin-off applications, one of which involves the more effective use of consultants. It is often desirable to obtain consultation on a very specific topic either as part of a training program or in planning and program review. Telecommunications may be applied as a means of securing short (one or two hours) consultations on these topics. This would make better use of existing expertise at a lower cost.

253 Development of a Competency-Based Staff Development Program for Vocational Evaluators

Principal Investigator:	**Geraldine Hansen, Ed.D.**	
Status:	**Continuing**	
Dates:	**July 1975–June 1978**	
Cost:	**Annual $25,998** **RT Annual $18,798**	**Projected Total $54,000** **RT % of Annual Total 72%**
Annual Report Reference:	**# 6, Page 241, R-25**	

OBJECTIVES: The study is directed toward assessing the competency needs and levels of vocational evaluators to provide quality services to the handicapped. The objectives are as follows:

1. To coordinate action with various professional groups and training/education facilities to provide input into the project's design and relevancy, to avoid duplication of effort and to disseminate project's findings.
2. To ascertain competency statements which reflect the task requirements of the vocational evaluation.
3. To determine the relative importance of competency statements in relation to job requirements.

METHODOLOGY: The procedure involves devising a questionnaire containing competency statements concerning vocational evaluator job requirements, having a select sample rate the importance of these statements, analyzing data for significance and common task requirements, and repeating the procedure as necessary to refine the data for meaningful impact to training/education programs and professional groups.

FINDINGS TO DATE: An initial statement pool of over 2500 competency items has been screened and reduced to 175 competency statements relating to vocational evaluator task requirements. The statements were administered to groups of 116 rehabilitation educators, students, and practicing vocational evaluators who were asked to rate the importance of each statement and indicate where that skill could best be acquired. Biographical data was collected on each respondent and reliability checks were made on the ratings.

Most of the 175 competency statements were perceived by the respondents to be important knowledges, skills, and abilities for an entry level evaluator. Although the findings suggest the instrument may lack discriminatory power, the 175 statements were developed from an initial analysis fo 2500 statements, thereby increasing the applicability of the statements directly to the skills of the vocational evaluator. Thus, it is reasonable to expect the competency statements would be perceived as important by the respondents.

Since the importance of the competency statements has been determined, continued analysis will focus on screening out the low priority statements for the purpose of analyzing the other competency statements by category or subject area and learning approaches in relation to identifying training units for staff development training.

APPLICABILITY: It is anticipated that the results of this research will be widely used by short-term and long-term training programs for rehabilitation personnel. The state VR program may expect to directly benefit from this usage since improved evaluation will be provided to clients referred to rehabilitation facilities. The availability of validated training units may also encourage the development of new training programs for facility personnel.

An additional possible application of the results of the project is the use of the assessment procedures to be developed in a competency-based certification program for evaluators. Currently there are no universally accepted "standards" for certifying these individuals, but the assessment procedures to be developed in this project will lend themselves to this purpose.

254 Factors Influencing Counselors Determination of Client Eligibility and Referral for Facility Services

Principal Investigator: **Frederick E. Menz, Ph.D.**
Status: **Continuing**
Dates: **March 1977-October 1979**
Cost: **Annual $38,432** **Projected Total $46,800**
RT Annual $27,286 **RT % of Annual Total 71%**
Annual Report Reference: **#6, Page 17, R-26**

OBJECTIVES: The primary goal of this project is to reduce knowledge gaps with respect to eligibility determination and to generate new knowledge which would result in decreasing time, cost, and errors currently incurred in eligibility determination. Specifically the project examines the decision-making process of the VR counselors and the exchange of information via referral requests and reports. The objectives of the study are to determine:

1. Whether the sequence and number of informational reports effect outcome eligibility decisions.
2. Whether there exists certain optimal patterns and types of information that affect decisions.
3. Whether critical content statements within a report bias the decision-making process.
4. What factors affect the referral requests.
5. What factors affect the interpretation of the referral report.

METHODOLOGY: The procedures for this study vary according to the hypothesis under investigation. Throughout, though, the participating rehabilitation counselor simulates eligibility determination and/or planning of subsequent services. Six cases represent a cross section of rehabilitation risk and severity groups. Each case simulation provides 20 medical and non-medical reports and case-notes from which the subject can select and use in eligibility determination and/or planning decisions. Detailed information on the methods used to accomplish the separate objectives can be found in the Center's Progress Report #6.

FINDINGS TO DATE: From a prior study, it was found that VR counselors use anywhere from 3 to 14 referral requests prior to making an eligibility decision. However, the number, type, and sequence of selecting reports does not appear to affect the eligibility decision. The present study is to examine factors in the content of the report on referral system which bears most heavily on the decisions of eligibility and service referrals.

APPLICABILITY: The results of this project are anticipated to have one of the following uses: (1) the determination of guidelines for assessment and eligibility determination with specific client groups which could be used to establish case review standards; (2) the determination of critical report content which could be used to establish guidelines for preparing reports as well as performance evaluation of professional consultants; (3) the determination of the types of biases which occur in making referrals and preparing reports which could be used to develop guidelines for referral and report writing.

Additionally, the results will provide basic information regarding the eligibility determination process which can be used in both pre-service and in-service counselor training programs.

The case vignettes used in this project will be packaged in the form of a training program on eligibility determination. This package could be used by rehabilitation counselor training programs for pre-service training and by state Vocational Rehabilitation agencies for in-service training.

255 The Development of Programmatic Research Issues Within Vocational Assessment

Principal Investigator:	**Charles Coker, Ph.D.**	
Status:	**New**	
Dates:	**June 1977-February 1982**	
Cost:	**Annual $39,932** **RT Annual $28,786**	**Projected Total $143,000** **RT % of Annual Total 72%**
Annual Report Reference:	**#6, Page 123, R-30**	

OBJECTIVES: The goal of this project is to develop, implement, and monitor a line of programmatic research and research utilization activities in the area of client selection and rehabilitation planning, with a particular focus upon those severely disabled persons who are referred to rehabilitation facilities for assessment and evaluation of rehabilitation potential.

This goal will be attained through the following specific objectives:

a. To identify researchable issues in the area of client selection and rehabilitation services planning, using the Center Advisory Committee, RSA R&E strategy, state rehabilitation agency personnel, rehabilitation facility personnel, and other input sources.

b. To develop a programmatic research strategy and research utilization plan based upon identified researchable issues, knowledge gaps, and priority concerns.

c. To prepare issue analysis and position papers based on literature reviews which identify specific knowledge gaps and which formulate researchable problems.

d. To conduct pilot studies which demonstrate research feasibility and/or resolve methodological and instrumentation issues related to identified knowledge gaps and researchable problems.

e. To make available for dissemination, research findings not included in other projects.

f. To develop research project proposals for submission to the Center's Advisory Committee, RSA Regional Office, and RSA Special Centers Office for review and approval.

g. To review the findings of Center programmatic research activities with the Center training section to insure that optimal dissemination and utilization of all finds is occurring.

h. To monitor and evaluate Center programmatic research and research from other sources related to client selection, rehabilitation planning, and the use of vocational evaluation procedures in client assessment and planning with the purpose of periodically revising the programmatic research strategy, research priorities, research activities, and research dissemination and utilization procedures.

METHODOLOGY: The purpose of this project is to deal with these needs by: (1) conducting a systematic analysis and issue identification on the role and function of facility based vocational assessment and evaluation programs in the state vocational rehabilitation agency eligibility determination and individualized planning processes; (2) developing a programmatic research strategy which will reduce or remove the knowledge gaps related to the identified issues; (3) developing specific research projects which will deal with knowledge gaps in relation to specific proposals; (4) integrating the findings of these projects, as well as the findings of research by others, into a systematic body of knowledge; (5) allocating resources for Center research and joint research into critical areas.

FINDINGS TO DATE: Besides the initial purpose of organizing research strategies in the Center's mission area, a primary purpose of this project is to stimulate interest through the dissemination of research conducted by students in various aspects related to facility services and delivery. The findings or results of this project to date, therefore, are the following student research:

Adamczak, M. A Survey of the Implementation of Vocational Evaluation Results. August, 1977.

Bashynki, T. Work Values Among First and Recidivist Offenders. August, 1977.

Bode, M. Characteristics of Appropriate and Inappropriate Referrals for Vocational Evaluation. May, 1974.

Braminz, B. The Usefulness of a Job Site Tour as a Method of Occupation Exploration. August, 1975.

Browers, E. The Effects of Practice and Progressive Part Training and Work Sample Performance of the Mentally Retarded. August, 1977.

Depies, S. A. The Use of Information in Vocational Decision-Making By Disabled Persons. August, 1977.

Esser, C. Inter-Rater and Inter-Item Reliability Study of the Employability Assessment Scale. August, 1976.

Fisher, G. The Inter-Rater Reliability of the Functional Capacities Inventory. December, 1977.

Fried, J. Disabled Person's Use of Information in Vocational Decision-Making. August, 1977.

Goodman, R. The Effect of Muzak on Shop Performance in a Work Activity Center. August, 1977.

Holmes, T. Over Door Assembly and Disassembly. August, 1975.

Johnson, T. Johnson Shipping Clerk Job. February, 1975.

Kennedy, M. Changes in Task-Specific Self Concepts After Vocational Evaluation. May, 1973.

Kramer, C. Use of Job Analysis to Initiate Systematic Situational Assessment at the Eau Claire County Hospital. January, 1973.

Kruel, D. Client Behavior in Two Rehabilitation Programs. December, 1975.

Mann, C. A Human Factors Checklist for Vocational Evaluators. December, 1972.

Mason, V. Procedures of Follow-up Programs in Rehabilitation Facilities. August, 1974.

McLaughlin, L. Occupational Stereotyping of Sex and Disability in the Vocational Evaluation Process. August, 1977.

Mueller, J. Relationship Between Work Reinforcers, Vocational Needs and Reported Job Satisfaction for Vocational Evaluators. May, 1973.

Peck, D. A Study of the Use of Evaluation in High School Programs for the Hearing Impaired. August, 1976.

Pettit, R. The Job Experience Kits as Vocational Evaluation Procedures. August, 1973.

Pozarski, M. Pre-Knowledge of Acceptable Performance and Goal Setting in a Work Evaluation Situation. May, 1975.

Schlottman, V. Effects of Modeling on Work Behavior. December, 1976.

Schober, D. A Review and Examination of Theories of Employability. May, 1972.

Tanner, D. A Situational Assessment Manual. November, 1973.

Vincent, M. D. The Relationship Between Inventoried Interests and Occupational Areas Recommended for Clients After Vocational Evaluation. August, 1975.

APPLICABILITY: The project has implications for change in policy, program, and practice. They include: (1) policy—the identification of research priorities and allocation of research resources; (2) program—identification of programming issues, knowledge gaps, and the development of new knowledge needed to reduce the gaps and resolve the issues; (3) practice—the identification of priority practice issues and knowledge gaps, and the development of practices and techniques to resolve the issues; and (4) spinoff—the technique of increasing the utilization of Center research findings through stimulation and support of research by others in the rehabilitation community.

256 Effects of the Use of Different Types of Norms on the Vocational Recommendations and Occupational Decisions Made by Vocational Evaluators

Principal Investigator:	**Geraldine Hansen, Ed.D.**	
Status:	**New**	
Dates:	**July 1977-June 1978**	
Cost:	**Annual $43.681** **RT Annual $36,481**	**Projected Total $36,481** **RT % of Annual Total 83%**
Annual Report Reference:	**#6, Page 147, R-31**	

OBJECTIVES:

1. To determine whether the types of norms used (client, general population, or competitive) affect the clinical judgments made by vocational evaluators about severely disabled persons with reference to a specific occupation.

   It is hypothesized that making vocational recommendations (i.e., broad recommendations relative to level of employability, areas of work, worker functioning level, and service needs) is a clinical judgment process which is relatively insensitive to shifts in type of norm. It is further hypothesized that making occupational decisions (decisions regarding placeability, trainability, or non-suitability with reference to specific occupations) is an actuarial decision-making process which is sensitive to changes in type of norm: specifically, the use of competitive as opposed to client norms increases the number of "screen-out" and investigatory decisions (more information needed) made with severely disabled persons.

METHODOLOGY: Vocational information containing client, general population, or competitive norms at different levels of functioning (above average, average, or below average) were given to 76 participating vocational evaluators. The evaluators were asked to decide whether they would recommend that the client should, with respect to a specific occupation, (1) seek employment in that occupation, (2) receive training in that occupation, (3) be further evaluated in that occupation, or (4) not be considered for that occupation.

FINDINGS TO DATE: Preliminary analysis of the data did not confirm a priori expectations. Generally, client norms did not result in more screen-out decisions (4) than did competitive or general population norms across all levels of client functioning (above, average, below). Surprisingly, however, significantly more investigatory (3) and screen-out (4) decisions were made with client norms than with general population and competitive norms when the level of functioning for the client was labeled as above average for all three norms. Further analysis of these data are being conducted as well as data being collected on their effect on the clinical decisions of vocational evaluators.

APPLICABILITY: The importance of this project is twofold: (1) it will attempt to show that the use of "competitive norms" (which are a valued characteristic of assessment materials according to many evaluators and counselors) may produce an effect which is opposite that desired and valued by the state-federal VR program (i.e., may result in restriction of employment opportunity for the severely disabled); and (2) it will attempt to show that vocational recommendations (which are commonly used by counselors and clients for eligibility determination and program planning) are made via a clinical judgment process which is reasonably independent of the type of norm used. Hence, costly efforts to produce and develop an industrial norm may not be necessary.

Since the project topic was designated as a "critical issue" by a knowledgeable group of vocational evaluation materials developers, trainers, and service deliverers, it is anticipated that project results will be used by these and similar persons to determine the types of norms which are most suitable for use in vocational evaluation programming. Similarly, since the results should indicate possible adverse effects of using certain types of norms with severely disabled persons undergoing vocational evaluation, they can be used by policy makers and program developers at the local, state, regional, and national levels for establishing guidelines and standards for work sample norms to be used with the severely disabled. The latter could preclude faulty "screen out" and restriction of opportunity occurring with this priority group.

University of California/San Francisco (RT-23)
Research and Training Center in Deafness and Mental Health

CORE AREAS

Work Adjustment as a Function of Self-Image and Mental Health

Studies which will allow the Center to make predictions about the vocational adjustment of deaf people and to test the predictions with follow-up data on actual vocational performance. Results of this research will provide rehabilitation counselors and administrators with information that should lead to better understanding and more effective treatment of their clients.

Improving Clinical Training of Personnel Working with Deaf

Development of measures of the trainee counselors' knowledge of deafness, their knowledge of clinical principles and their behavioral effectiveness. These measures will be used to assess changes as a result of the training program.

Communication as It Affects the Vocational Rehabilitation Process for the Deaf

Investigating the contribution of the communicative competence of clients and counselors; as well as investigating the effect of introducing interpreters into the rehabilitation setting.

Evaluation of Therapeutic Intervention for the Deaf

Investigation into the use of skilled interpreters in the therapeutic process – crisis intervention, family therapy and psychosocial testing – which may open up pathways for professionals new to the field of deafness; and exploring the feasibility and optimal timing of developmental compensation.

Evaluation of the Mental Health Needs of the Multiple-Handicapped Deaf

Research to 1) provide for further evaluation of the needs of severely disabled deaf and 2) develop ways to best meet those needs through the available clinical services or through the creation of specialized services within the Center.

Special Problems of Members of Deaf Minority Groups

Research in similarities between the deaf and racial/ethnic minority groups and the personal and social consequences of the combined stigma. Anthropological research among the general deaf community, and cross-cultural investigations of the treatment and rehabilitation of deaf persons in the various subgroups would add a significant dimension to the Center's research program.

Development of Guidelines for Clinical Histories and Appropriate Clinical Forms

Studies aimed at determining background variables which are inappropriate for other groups but which are essential for an accurate assessment of deaf clients (e.g., degree, onset, and etiology of loss; and educational and audiological history). Such a description would be useful to other centers in planning services for deaf clients and in the development of clinically and vocationally oriented forms.

UNIVERSITY OF CALIFORNIA/SAN FRANCISCO

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San Francisco, California 94143

PROJECT TITLES BY FY 1978 STATUS

NEW **ABSTRACT NO.**

A Longitudinal Study of Self-Image and Work Adjustment of Young Deaf Adults (H. Schlesinger, M.D.) 257

Crucial Variables in the Clinical Effectiveness of Personnel Who Work with the Deaf (H. Schlesinger, M.D.) 258

The Development of a Communication Skills Profile (H. Schlesinger, M.D.) 259

University of California/San Francisco

257 A Longitudinal Study of Self-Image and Work Adjustment of Young Deaf Adults

Principal Investigator: **Hilde Schlesinger, M.D.**
Status: **New**
Dates: **October 1977-September 1980**
Cost: **Annual $74,931** **Projected Total $168,700**
RT Annual $69,369 **RT % of Annual Total 92.6%**
Annual Report Reference: **# 1, Page 5, R-1**

OBJECTIVES: To describe the vocational success and general well-being of a group of young deaf adults who are still in relatively early career stages.

To relate earlier obtained measures of self-image, psychosocial adjustment, communication skills, academic achievement, family climate and history to vocational success.

To use such relationships as a guide to the possible modification of earlier experiences so that the deaf student will have a better probability of achieving vocational success.

METHODOLOGY: In 1966-67, Meadow amassed a great deal of information on 116 students at the California School for the Deaf, Berkeley, California. The first step in studying this sample has been locating each individual and determining if he or she wishes to participate in this study. During this same time period, a literature search was conducted on the vocational characteristics of deaf adults. Based upon the finding of this survey, an interview schedule will be developed to use with the cooperating subjects. Information on vocational success will then be obtained and statistically related to the data collected twelve years earlier.

FINDINGS TO DATE: The sample to be studied now ranges in age from 18 to 30 years. Only a very few of these could still be at the California School for the Deaf, Berkeley. Letters describing the interest of the Center in contacting these students were circulated, providing the students the opportunity to indicate their willingness to participate without any invasion of their privacy. The vast majority of the students, however, had to be contacted through other means. These include (a) contact with socially active members of the adult deaf community to learn of the whereabouts of members of the sample, (b) advertisements in an alumni magazine, (c) checks with community services for the deaf, (d) attendance at social and athletic activities of the Berkeley School, (e) attendance at a reunion of the alumni, (f) a search of news columns and reports on alumni happenings, (g) checks of telephone listings in public directories and in post-secondary schools for the deaf such as NTID, Gallaudet and California State University, Northridge.

Two persons were known suicides. Addresses were not available for 17 other persons (leads on 5 of these have since been obtained). Two letters were returned, "addressee unknown". On the first round of letters 39 returned the forms with 4 declining to be interviewed. (2 of the 4 also denied researchers' permission to look at past academic records. Personal contact with two of these yielded agreement to participate.) On the second round, an additional 21 responded, with 4 refusals. Two wanted more information before they would consent to be interviewed. Personal contact at a school reunion yielded consents from an additional 16 persons.

In all, 65 have agreed to be interviewed so far. Since efforts to locate other members of the sample will continue, there appears to be reasonable probability that more than half of the original group can be studied. Because of cost considerations, it is likely that interviews may be confined to those who have remained in the Bay Area. Collaborative investigators may conduct interviews at other locations. An interview schedule was prepared in July and August and interviewing began in the Fall of 1978.

Preliminary to designing an interview schedule it seemed desirable to review the literature on vocational success with special reference to work previously conducted with the deaf. A paper is being prepared for submission to an appropriate journal.

APPLICABILITY: The information thus made available to schools and rehabilitation personnel may permit them to modify their practices in such ways as to improve the chances for vocational success for deaf clients.

University of California/San Francisco

258 Crucial Varibles in the Clinical Effectiveness of Personnel Who Work with the Deaf

Principal Investigator:	**Hilde Schlesinger, M.D.**	
Status:	**New**	
Dates:	**October 1977-September 1981**	
Cost:	**Annual $45,465** **RT Annual $39,465**	**Projected Total $194,000** **RT % of Annual Total 86.8%**
Annual Report Reference:	**# 1, Page 16, R-2**	

OBJECTIVES: To devise and validate measures of (1) knowledge of deafness and (2) knowledge of clinical principles.

To devise and validate relevant counselor personality measures, i.e., "ego strength", "need to be helpful", "capacity for detached empathy and sensitivity", and "ability to be self-critical".

To use the measures mentioned above as one means of determining the effectiveness of training of mental health workers.

METHODOLOGY: As a first step, surveys of the literature were conducted on (a) the effect of psychotherapy training, (b) psychotherapy with several different groups, i.e., the deaf, the impulsive, and the underprivileged. Previous research suggests that impulsiveness and low verbal skills are frequently found among deaf persons.

Next, separate measures will be devised to assess variables that are of interest, i.e., tests of knowledge about deafness and about mental health principles, as well as specified personality attributes. These measures will be validated and then used to assess success in the training of psychotherapists.

FINDINGS TO DATE: The literature sources surveyed in all cases were the computer stored abstracts compiled by N.I.H. and Psychological Abstracts. The first survey dealt with the effects of Psychotherapy Training. There were 101 indexed references, of which 25 were deemed significant enough to be copied and included in the library of the Center. The success of therapy with selected groups of clients, i.e., the deaf and the impulsive, yielded another 101 referenced articles with 41 deemed important enough to copy. Annotated bibliographies have been prepared for all these areas. A fourth survey, Psychotherapy with the Underprivileged, was completed in August, 1978.

APPLICABILITY: Those training procedures and instruments that show promise should enable other training centers to improve their training of therapists. This, in turn, should result in amelioration of some of the mental health problems which limit the vocational success of many deaf clients.

259 The Development of a Communication Skills Profile

Principal Investigator:	**Hilde S. Schlesinger, M.D.**	
Status:	**New**	
Dates:	**January 1978-December 1978**	
Cost:	**Annual $21,431** **RT Annual $18,431**	**Projected Total $60,700** **RT % of Annual Total 86%**
Annual Report Reference:	**# 1, Page 93, R-3**	

OBJECTIVES: The objective of this project is to develop a Communication Skills Profile for rating the following: (a) Oral speech and speechreading; (b) Signed English (expressive and receptive); (c) Ameslan (expressive and receptive); (d) Fingerspelling (expressive and receptive); and (e) Print (writing and reading).

METHODOLOGY: A Communication Skills Profile is being developed that enables a therapist to describe easily and rapidly everyday-life communication skills of deaf clients with a series of ratings. To date, the Profile has undergone four successive revisions in order to achieve precise delineations of communication skills and a format that makes the Profile quick and easy to use. Currently, therapists are rating the communicative proficiency of themselves and that of their child and adult deaf clients. A comparison of clients' communication skills before and after six weeks of psychological counseling is being initiated. Additional studies are planned in order to determine further the Profile's clinical value.

FINDINGS TO DATE: The Communication Skills Profile being developed is a refinement of an inventory being used at Kendall Demonstration Elementary School and at the Deafness Research and Training Center at New York University. The profiles of median scores for four child and four adult clients show some interesting differences between the two groups. The biggest differences, in favor of the adults, are for Ameslan and fingerspelling. This result suggests that, as the deaf child becomes an adult, the biggest changes occur for these two skills. The high Ameslan and fingerspelling scores for the adults in conjunction with the low scores for all communication skills for the children, suggest that while the adults can express themselves adequately, the children cannot. These initial findings are tentative; no tests of statistical significance were computed, the sample was small, and the Profile needs further revision.

The variability of the scores was examined for each scale. For each scale, scores covered, or almost covered, the high (5) vs. low (1) continuum. The score ranges were: oral, 1-4; signed English, 2-5; Ameslan, 1-5; fingerspelling, 2-5; and print, 1-4. This result suggests that the scale scores allow for rating variations in the communication skills of different clients.

The differences between the communication profiles of the child and adult patients seemed consistent with informal observations of these clients at the mental health service. This consistency in conjunction with the data on score variability suggests that further work with the profile would probably yield an instrument that describes communication skills of deaf persons in a clinically useful way.

APPLICABILITY: The profile may be useful as part of the training program on mental health and deafness. If appropriate, the Clinical staff will incorporate the scale into the intake procedures. The scale will also be used to obtain descriptive statistics on client communication and relate these to therapeutic outcomes.

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